

# **PROJECT MANUAL**



## **CONVEYANCE REPLACEMENT & MODERNIZATION**

**201734681**

# **PART I**

## **PROJECT REQUIREMENTS**

CITY & COUNTY OF DENVER  
DEPARTMENT OF AVIATION

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF AVIATION  
DENVER INTERNATIONAL AIRPORT  
CONVEYANCE REPLACEMENT & MODERNIZATION  
NO. 201734681**

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**INSTRUCTION TO PROPOSERS  
CITY AND COUNTY OF DENVER  
DEPARTMENT OF AVIATION**

**IB-12 QUANTITIES IN THE TASK ORDER FORM ENTITLED SCHEDULE OF PRICES AND QUANTITIES (PART 2 OF THE TASK ORDER FORMS)**

Items are designated as Lump Sum. Lump Sum prices are subject to negotiation and clarification by the City and County of Denver.

Payment to the Contractor will be based on the actual quantities of work performed, measured, and accepted or materials furnished in accordance with the Contract Documents.

Any of the estimated quantities of work and materials shown in the Task Order Forms may each be increased, decreased, or omitted as provided in the General Conditions, Special Conditions, or Technical Specifications.

**IB-13 TASK ORDER GUARANTEE; BONDS; INSURANCE**

As a guarantee of good faith on the part of the Contractor, each Task Order must be accompanied by a Task Order guarantee consisting of either a certified or cashier's check made payable without condition to the order of the City and County of Denver or a Task Order Payment and Performance bond written by an approved corporation surety in favor of the City and County of Denver. A Task Order Bond form for execution by the Contractor is supplied with each set of contract documents. **IF A TASK ORDER BOND IS USED, IT MUST BE THE FORM OF TASK ORDER BOND SUPPLIED WITH THE CONTRACT DOCUMENTS.**

**IB-16 SITE INSPECTION AND INVESTIGATIONS**

Prior to submitting an offer, the Contractor shall inspect the work site and its surroundings. A site visit may be undertaken at any time. For purposes of the contract, it shall be conclusively presumed that the Contractor has made a thorough inspection of the site and has waived the right to later claim extra payment or time extensions for conditions which would have been evident during an inspection.

Drawings and specifications, defining the work to be done, were prepared on the basis of interpretation by design professionals of information derived from investigations of the work site and site condition data provided by the City. Such information and data are subject to sampling errors, and the interpretation of the information and data depends to a degree on the judgment of the design professional. In view of this, the Contractor is invited to make additional investigations as the Contractor's judgment dictates the

need for such investigations.

Because the Task Order information cannot be guaranteed, the Contractor shall have assumed the risks attendant to successful performance of the work except for the risk of encountering differing site conditions which are defined in the General Conditions and shall never make claim for additional payments or time extensions on the grounds that the nature or amount of work to be done was not understood by the Contractor at the time of the RFP.

#### **IB-17 MINORITY/WOMEN BUSINESS ENTERPRISE (MBE/WBE) REQUIREMENTS**

This Contract is subject to all applicable provisions of Article III Divisions 1 and 3 of Chapter 28 of the DRMC (the "M/WBE Ordinance") and any Rules or Regulations promulgated pursuant thereto.

In accordance with the requirements of the M/WBE Ordinance, the Contractor is committed to, at a minimum, meet the participation goal of eight percent (8%) established for this Project, utilizing properly certified M/WBE subcontractors and suppliers. The Goal must be met with certified participants as set forth in Section 28-55, D.R.M.C. or through the demonstration of a sufficient good faith effort under Section 28-67, D.R.M.C. For compliance with good faith effort requirements under Section 28-62(b)(2), the percentage solicitation level required for this project is 100%. The Contractor identified in its Proposal MBE and/or WBE firms with which it intends to subcontract for services under this Agreement.

In accordance with Section 28-60(b) and Rules and Regulations promulgated pursuant thereto, the Director has authorized the utilization of a compliance plan to address the Goal for this Project. Therefore, at the time of proposal submittal, the contractor must include in their proposal only the Commitment Page which is included within this RFP. Letters of intent nor a compliance plan are required to be submitted with the proposal. The Contractor, when notified by DSBO, will prepare and present for review and approval of the Director a compliance plan for meeting the requirements of the M/WBE Ordinance. At a minimum, the proposed compliance plan shall comply with all requirements of the Rules and Regulations pertaining to such plans and shall be approved in writing by the Director. Upon such approval, the plan is hereby incorporated into this Contract by reference and may also be included as an Exhibit. Furthermore, the contractor will be required to submit letters of intent throughout the course of the project.

Without limiting the general applicability of the foregoing, the Contractor acknowledges its continuing duty, pursuant to Section 28-72 DRMC, to meet and maintain throughout the duration of this Contract its participation and compliance commitments and to ensure that all Subcontractors subject to the Ordinance also maintain such commitments and compliance. Failure to comply with these requirements may result, at the discretion of the Director of the Division of Small Business Opportunity ("DSBO"), in the imposition of sanctions against the

Contractor in accordance with Section 28-77, DRMC. Nothing contained in this Paragraph or in the referenced City ordinance shall negate the City's right to prior approval of Subcontractors, or substitutes therefore, under this Contract.

The proposer understands that if change orders or any other contract modifications are issued under the contract, the proposer shall have a continuing obligation to immediately inform DSBO in writing of any agreed upon increase or decrease in the scope of work of such contract, upon any of the bases discussed in Section 28-73 of the Ordinance, regardless of whether such increase or decrease in scope of work has been reduced to writing at the time of notification.

The proposer understands that if change orders or other contract modifications are issued under the contract, that include an increase in scope of work of a contract for construction, reconstruction, or remodeling, whether by amendment, change order, force account or otherwise which increases the dollar value of the contract, whether or not such change is within the scope of work designated for performance by an MBE/WBE at the time of contract award, such change orders or contract modification shall be immediately submitted to DSBO for notification purposes. Those amendments, change orders, force accounts or other contract modifications that involve a changed scope of work that cannot be performed by existing project subcontractors or by the contractor shall be subject to a goal for MBE/WBEs equal to the original goal on the contract which was included in the proposal. The contractor shall satisfy such goal with respect to such changed scope of work by soliciting new MBE/WBEs in accordance with Section 28-73 of the Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-75 (c) of the Ordinance. The contractor or consultant shall supply to the director the documentation described in Section 28-75 (c) of the Ordinance with respect to the increased dollar value of the contract.

All proposers are charged with knowledge of and are solely responsible for complying with each and every provision of the Ordinance in making a bid and, if awarded, in performing the work described in the Contract Documents. Failure to comply with these provisions could constitute cause for rejection of a bid or subject the selected contractor to sanctions set forth in the Ordinance. These instructions are intended only to generally assist the proposer in preparing and submitting a compliant bid. Should any questions arise regarding specific circumstances, proposers must consult the Ordinance or contact the Project's designated DSBO representative at (303) 342-2180.

### **IB-18 DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS**

The City and County of Denver encourages, but does not require, participation of independent partnerships with SBEs, MBEs, WBEs, and other business enterprises in supply chain activities, prime/subcontractor partnerships, and joint ventures for all contracts and purchase orders. Failure to participate or disclose this information will not impact the award of the contract or purchase order. Voluntary disclosure of such

independent partnerships to the City, if any, will be forwarded the DSBO for recording purposes only.

Using the form contained in the Bid Forms, entitled "Diversity and Inclusiveness in City Solicitations Information Request Form", please state whether you have a diversity and inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the Diversity and Inclusiveness in City Solicitations Information Request Form will provide an opportunity for City contractors/consultants to describe their own diversity and inclusiveness practices. Contractors/consultants are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor/consultant's current practices, if any. Diversity and Inclusiveness information provided by City contractors/consultants in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable information provided by or obtained from contractors/consultants will be in such reports.

#### **IB-20 SUBCONTRACTOR LISTS IN TASK ORDER**

The Contractor shall, on the forms included in the TNP Forms, identify each element of the work which the Contractor plans to subcontract, provide an estimate of the total cost to perform each element, and include the name and address of the proposed subcontractor.

#### **IB-21 PERMIT FEES**

The Contractor agrees to pay the permit fees associated with the construction of this project described in General Condition 317, and in the Special Conditions and Technical Specifications.

#### **IB-22 TAXES**

1. General. Contractor is referred to the General Conditions, G.C. 323, as to taxes to which they may be subject in performing the Work under this contract, including but not limited to sales and use taxes and the Denver Occupational Privilege Tax. The following instructions are to be considered along with the General Conditions and not in lieu of them.
2. Sales and Use Tax. Construction and building materials sold to contractors and subcontractors for use on structures, roads, streets, highways, and other public works owned by the City and County of Denver at Denver International Airport are exempt from state, RTD, and Cultural Facilities District sales and use taxes. However, such materials will be subject to sales and use taxes imposed by the City and County of Denver.



3. Exemption Certificates – Sales and Use Tax. It is responsibility of the Contractor and its subcontractors to apply to the Colorado Department of Revenue (“CDOR”) for a certificate, or certificates, of exemption indicating that their purchase of construction or building materials is for a public project, and to deliver to the City copies of such applications as soon as possible after approval by the CDOR. Contractors shall not include in their Task Order amounts the exempt State, RTD, and Cultural Facilities District Sales and Use Taxes.
4. Denver Occupational Privilege Tax. Any employee working for a contractor or a subcontractor who earns over \$500 working in Denver during a calendar month is subject to the payment of the Employee Occupational Privilege Tax. The Contractor and any subcontractor must pay the Business Occupational Privilege Tax for each of its employees who are subject to such tax.

### **IB-23 NONDISCRIMINATION IN THE AWARD OF CITY CONTRACTS**

It is the policy of the City and County of Denver to prohibit discrimination in the award of construction contracts and subcontracts for public improvements. Further, the City and County of Denver encourages contractors to utilize minority and women owned businesses and to divide the construction work into economically feasible units or segments to allow the most opportunity for subcontracting.

### **IB-24 MINORITY/WOMEN BUSINESS ENTERPRISE (MBE/WBE) REQUIREMENTS**

Divisions 1 and 3, Article III of Chapter 28 of the Denver Revised Municipal Code (Sections 28-31 to 28-36 and 28-52 to 28-90, D.R.M.C.) (the "Ordinance") apply to this Project and are incorporated into this Contract by reference. Generally, the Ordinance provides for the adoption of a good faith goals program, to be administered by the Division of Small Business Opportunity (DSBO), devised to provide increased bidding opportunities for Minority/Women Business Enterprises (MBE/WBEs). As such, each bidder must comply with the terms and conditions of the Ordinance in making its bid and, if awarded the Contract, in performing all Work thereunder. A bidder's failure to comply with the Ordinance, any Rules or Regulations promulgated pursuant thereto, or any additional requirement contained herein shall render the bid non-responsive and shall constitute cause for rejection. Failure by the contractor awarded the contract to comply with Ordinance requirements during the performance of the contract is a material breach of the contract, which may result in the termination of this contract, the imposition of sanctions or such other remedy, as deemed appropriate by DSBO. Copies of the Ordinance and its accompanying Rules and Regulations are available for the use and review of bidders from DSBO.

In order to comply with the bid requirements of the Ordinance, a bidder shall either meet the established project goal or, in the alternative, demonstrate that the bidder has made sufficient good faith efforts to meet the goal in accordance with the Ordinance. In preparing a bid to meet the established Project goal, bidders should consider the following instructions relating to compliance with the Ordinance:

1. Under the Ordinance, the Director of DSBO ("Director") is directed to establish project goals for expenditures on construction, reconstruction and remodeling work performed for the City and County of Denver. The specific goal for this project is stated in the Notice of Invitation for Bids bound herein.
2. In preparing its bid, each bidder shall list on the Bid Form pages entitled "List of Proposed Minority/Women Business Enterprise Bidders, Subcontractors, Suppliers, Manufacturers, Manufacturers' Representatives or Brokers" the name, address, work description/supply, committed level of participation and other required information for each MBE/WBE of any tier which the bidder intends to use in performing the work on this Project. **Only the MBE/WBEs identified and the precise levels of participation listed for each on the Bid Form page, at the time of bid opening, will be considered in determining whether the bidder has met the designated participation goal. Additional, revised or corrected participation submitted after bid opening will not be considered. MBE/WBE bidders may count self-performance or joint venture activity in meeting the MBE/WBE project goal, but only for the scope of work performed as a commercially useful function and at a percentage level the MBE/WBE will be performing itself.**
3. All MBE/WBEs listed on the Bid Form must be properly certified by the City on or before the date bids are opened in order to count towards meeting the designated goal. DSBO maintains an MBE/WBE Construction Directory ("Directory"), which is a current listing of MBE/WBEs that have been certified by the City. A copy of the Directory is available from DSBO, located at 201 W. Colfax, Dept. 907, Denver, Colorado, or on the website located at [www.denvergov.org/DSBO](http://www.denvergov.org/DSBO) and will also be made available at the pre-bid meeting. Bidders are encouraged to use the Directory to assist in locating MBE/WBEs for the work and supplies required on the Project. Bidders are reminded that changes may be made to the Directory at any time in accordance with the City's MBE/WBE Ordinance and procedures established to administer this program, and that a current copy of the Directory must always be used in preparing a bid. MBE/WBE certification or listing in the Directory is not a representation or warranty by the City as to the qualifications of any listed MBE/WBE.
4. In accordance with the provisions of the Ordinance, DSBO will evaluate each bid to determine the responsiveness of the bid to the requirements of the Ordinance. In determining whether a bidder's committed level of participation meets or exceeds the stated MBE/WBE goal, DSBO shall base its calculation of applicable amounts and percentages on the total base bid amount, not including any listed alternates, of each bid as follows:
  - a. The bid information provided by the agency will be used to determine the total base bid amount of each bid. Each bidder's total base bid amount will be multiplied by the MBE/WBE percentage established for the project to determine the exact dollar amount of required MBE/WBE

participation for the Project. This amount will then be compared against the exact dollar amounts for the MBE/WBEs committed for participation by the bidder. If the total dollar amount of participation listed meets or exceeds the established MBE/WBE dollar amount goal listed, then DSBO will determine that the goal has been met.

- b. In addition, DSBO will determine the exact commitment percentage for each listed MBE/WBE by dividing the dollar amount listed for each MBE/WBE by the total base bid dollar amount submitted by the bidder. These individual percentages, when totaled for all listed MBE/WBEs, will establish the total committed percentage level of MBE/WBE participation that the bidder must comply with during the life of the contract. In all cases, the committed percentage level of MBE/WBE participation must equal or exceed the assigned MBE/WBE goal for the Project.
- c. In providing the exact dollar amount of participation for each listed MBE/WBE, a bidder should take care never to round up in determining whether or not the total of these amounts meets or exceeds the established percentage goal. The goal must be met or exceeded by dollar amounts and percentages in order for DSBO to determine that the bidder has met or exceeded the applicable MBE/WBE goal.
- d. As previously mentioned, compliance with the MBE/WBE goal will be determined on the base bid alone. If a bid contains alternates, participation contained in any alternate will not count towards satisfaction of the Project goal. However, should any designated alternate be selected by the City for inclusion in the contract ultimately awarded, the MBE/WBE goal percentage level submitted at bid time, on the base bid, will also apply to the selected alternates and must be maintained for the life of the contract on the total contract amount, including any alternate work. Thus, even though such participation will not be considered in evaluating bids, bidders are urged to consider participation in preparing bids for designated alternates.
- e. On projects where force account or allowance bid items have been included, bidders must meet the MBE/WBE goal percentage based upon the total base bid, including all such items that are submitted to the City. However, when a force account or allowance is designated by the City to be either performed or purchased from a specific company, the bidder may back out the dollar amount of the force account or allowance from the total base bid and meet the MBE/WBE goal on the remaining reduced amount.
- f. On bids that, at the time of bid opening, are equal to or exceed Five Million Dollars (\$5,000,000.00), including any alternates that may be

selected, only sixty percent (60%) of the value of the commercially useful function performed by MBE/WBE suppliers shall count toward satisfaction of the Project goal. On Projects under Five Million Dollars (\$5,000,000.00) the value of the commercially useful function of MBE/WBE supplier(s) will count at a one hundred percent (100%) level. Manufacturers' representatives and packagers shall be counted in the same manner as brokers.

- g. **In utilizing the MBE/WBE participation of a Broker,** only the bona fide commissions earned by such Broker for its performance of a commercially useful function will count toward meeting the Project goals. The bidder must separate the bona fide brokerage commissions from the actual cost of the supplies or materials provided to determine the actual dollar amount of participation that can be counted towards meeting the goal.
5. On or before the third (3<sup>rd</sup>) working day after bid opening, all of the Bidders are required to submit an executed "MBE/WBE Letter of Intent" for each MBE/WBE listed on the Bid Form as a joint venture member, subcontractor, supplier, manufacturer, manufacturers' representative or broker of any tier. An MBE/WBE Bidder needs to submit a Letter of Intent for any portion of self-performed work to count towards MBE/WBE utilization. , Each Letter of Intent shall be submitted only for the MBE/WBEs listed at the time of bid opening, since this is the only participation that will be counted toward satisfaction of the project goal. A form for the MBE/WBE Letter of Intent is included with the Bid Form. The MBE/WBE Letter of Intent is a written communication from the Bidder to the City evidencing an understanding that the Bidder has or will enter into a contractual relationship with the MBE/WBE or that its subcontractor(s) and supplier(s), manufacturer(s), manufacturers' representative(s) and broker(s) will do so. Each MBE/WBE Letter of Intent shall be accompanied by a copy of the City and County of Denver's MBE/WBE certification letter for each proposed MBE/WBE identified at bid time. Bidders are urged to carefully review these Letters before submission to the City to ensure that they are properly completed and executed by the appropriate parties.

In preparing a bid to demonstrate a good faith effort, bidders should consider the following instructions relating to compliance with the Ordinance:

- 1. If any Bidder has not met the designated Project goal at the time the bids are opened or elects to present a good faith effort in lieu of or in addition to attempting to satisfy the designated Project goal, that Bidder shall submit, on or before the third (3<sup>rd</sup>) working day after the bid opening a detailed statement, with supporting documentation, setting forth its good faith efforts, made prior to bid opening, attempting to meet the established goal in accordance with Section 28-62 of the Ordinance. This statement shall address each of the items in Subsection (b) of that Section and any additional criteria that the DSBO

Director may establish by rule or regulation. A Bidder who fails to meet the Project goal and cannot show that it made a good faith effort to meet the goal shall be considered non-responsive.

2. The statement of good faith efforts shall include a specific response to each of the following as further defined by rule or regulation. A Bidder may include any additional information the Bidder believes may be relevant. Failure of a Bidder to show good faith efforts as to any one of the following items shall render its overall good faith showing insufficient and its bid non-responsive. Items (1) through (9) of Section 28-62, Subsection (b) of the Ordinance are set forth below:

- (1) The bidder or proposer must solicit through all reasonable and available means, the interest of all MBEs and WBEs certified in the scopes of work of the contract. The bidder or proposer must solicit the interest of such MBEs and WBEs within sufficient time, prior to the bid opening or date of final project-specific proposal in the case of a competitive selection process, to allow such MBEs and WBEs to respond to the solicitation. The bidder or proposer must determine with certainty if the MBEs and WBEs are interested by demonstrating appropriate steps to follow up initial solicitations.
- (2) The bidder or proposer must select portions of the work of the contract to be performed by MBEs and WBEs in order to increase the likelihood that the project goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate MBE and WBE participation as subcontractors or joint venturers, and for bidder or proposer self-performed work, as suppliers, manufacturers, manufacturer's representatives and brokers, all reasonably consistent with industry practice, even when the bidder or proposer would otherwise prefer to perform these work items with its own forces. The bidder or proposer must identify what portions of the contract will be self-performed and what portions of the contract will be opened to solicitation of bids, proposals and quotes from MBE and WBEs. All portions of the contract not self-performed must be solicited for MBE and WBE participation. The ability or desire of a bidder or proposer to perform the work of a contract with its own forces does not relieve the bidder or proposer of the responsibility to meet the project goal or demonstrate good faith efforts to do so.
- (3) The bidder or proposer, consistent with industry practice, must provide MBEs and WBEs at a clearly stated location with timely, adequate access to and information about the plans, specifications, and requirements of the contract, including bonding and insurance requirements, if any, to assist them in responding to a solicitation.

- (4) The bidder or proposer must negotiate in good faith with interested MBEs and WBEs and provide written documentation of such negotiation with each such MBE or WBE.
- (5) For each MBE or WBE which contacted the bidder or proposer or which the bidder or proposer contacted or attempted to subcontract or joint venture with, consistent with industry practice, the bidder or proposer must supply a statement giving the reasons why the bidder or proposer and the MBE or WBE did not succeed in negotiating a subcontracting, supplier, manufacturer, manufacturer's representative, broker or joint venture agreement, as applicable.
- (6) The bidder or proposer must provide verification that it rejected each non-utilized MBE and WBE because the MBE or WBE did not submit the lowest bid or it was not qualified. Such verification shall include a verified statement of the amounts of all bids received from potential or utilized subcontractors, suppliers, manufacturers, manufacturer's representatives, brokers or joint venturers on the contract, whether or not they are MBEs or WBEs. In making such a determination of not being qualified, the bidder or proposer shall be guided by the definition of qualified in section 28-54(42), but evidence of lack of qualification must be based on factors other than solely the amount of the MBEs or WBEs bid. For each MBE or WBE found not to be qualified by the bidder or proposer, the verification shall include a statement giving the bidder's or proposer's reasons for its conclusion. A bidder's or proposer's industry standing or group memberships may not be the cause of rejection of an MBE or WBE. A bidder or proposer may not reject an MBE or WBE as being unqualified without sound reasons based on a reasonably thorough investigation and assessment of the MBEs or WBEs capabilities and expertise.
- (7) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining bonding, lines of credit, or insurance as required by the City or by the bidder or proposer, provided that the bidder or proposer need not provide financial assistance toward this effort.
- (8) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining necessary and competitively priced equipment, supplies, materials, or related assistance or services for performance under the contract, provided that the bidder or proposer need not provide financial assistance toward this effort.

- (9) The bidder or proposer must use the DSBO MBE/WBE directories to identify, recruit, and place MBEs and WBEs.

In accordance with the provisions of the Ordinance, the bidder agrees that it is committed to meeting either the MBE/WBE participation goal or the MBE/WBE participation set forth in its statement of good faith efforts. This commitment must be expressly indicated on the "Commitment to Minority/Women Business Enterprise Participation" form included with the Bid Form. This commitment includes the following understandings:

1. The bidder understands it must maintain MBE/WBE goals throughout the performance of the Contract pursuant to the requirements set out in D.R.M.C. 28-72.
2. The bidder understands that it must establish and maintain records and submit regular reports, as required, that will allow the City to assess progress in achieving the MBE/WBE participation goal.
3. The bidder understands that if change orders or any other contract modifications are issued under the contract, the bidder shall have a continuing obligation to immediately inform DSBO in writing of any agreed upon increase or decrease in the scope of work of such contract, upon any of the bases discussed in Section 28-73 of the Ordinance, regardless of whether such increase or decrease in scope of work has been reduced to writing at the time of notification.
4. The bidder understands that if change orders or other contract modifications are issued under the contract, that include an increase in scope of work of a contract for construction, reconstruction, or remodeling, whether by amendment, change order, force account or otherwise which increases the dollar value of the contract, whether or not such change is within the scope of work designated for performance by an MBE/WBE at the time of contract award, such change orders or contract modification shall be immediately submitted to DSBO for notification purposes. Those amendments, change orders, force accounts or other contract modifications that involve a changed scope of work that cannot be performed by existing project subcontractors or by the contractor shall be subject to a goal for MBE/WBEs equal to the original goal on the contract which was included in the bid. The contractor shall satisfy such goal with respect to such changed scope of work by soliciting new MBE/WBEs in accordance with Section 28-73 of the Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-75 (c) of the Ordinance. The contractor or consultant shall supply to the director the documentation described in Section 28-75 (c) of the Ordinance with respect to the increased dollar value of the contract.

All bidders are charged with knowledge of and are solely responsible for complying with each and every provision of the Ordinance in making a bid and, if awarded, in performing the work described in the Contract Documents. Failure to comply with these provisions could constitute

cause for rejection of a bid or subject the selected contractor to sanctions set forth in the Ordinance. These instructions are intended only to generally assist the bidder in preparing and submitting a compliant bid. Should any questions arise regarding specific circumstances, bidders must consult the Ordinance or contact the Project's designated DSBO representative at (303) 342-2180.

## **IB-25 DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS**

Each Bidder shall, as a condition of responsiveness to this solicitation, complete and return the "Diversity and Inclusiveness in City Solicitations Information Request Form" with their Task Order.

Using the "Diversity and Inclusiveness in City Solicitations Information Request Form" please state whether you have a diversity and inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the "Diversity and Inclusiveness in City Solicitations Information Request Form" will provide an opportunity for City contractors to describe their own diversity and inclusiveness practices. Contractors are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor's current practices, if any.

Diversity and Inclusiveness information provided by City contractors in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable provided by or obtained from contractor's will be in such reports.

In order for the agency or City to consider the Task Order or proposal, Contractors must complete the electronic version of the Diversity And Inclusiveness In City Solicitations Form then **print the completed form and include the hard copy as part of its Task Order documents. A proposal or response to a solicitation by a contractor/consultant that does not include this completed form shall be deemed non-responsive and rejected.** The form is found at: <https://fs7.formsite.com/CCDenver/form161/index.html>

The Diversity and Inclusiveness form is separate from the requirements established by DSBO, and must always be completed regardless of whether or not there are any goals assigned to the project.

## **IB-26 WAGE RATE REQUIREMENTS**

Pursuant to Section 20-76 of the Revised Municipal Code, the Contractor selected to perform this contract shall pay mechanics, laborers and workers employed directly upon the site of the work the full amounts accrued at the time of payment, computed wage rates not less than those shown on the current prevailing wage rate schedule included in the contract Task Order documents and any addenda thereto.



If the term of the contract extends for more than one year, the minimum City prevailing wage rates that contractors and subcontractors shall pay during any subsequent yearly period or portion thereof shall be the wage rates in effect on the yearly anniversary date of the contract which begins such subsequent period. In no event shall any increases in prevailing wages after the first anniversary of the contract result in any increased liability on the part of the City and the possibility and risk of any such increase is assumed by all contractors entering into such contract with the City.

#### **IB-27 CONSTRUCTION SCHEDULING**

The Contractor should refer to the General Conditions, Special Conditions, and Division I of the Technical Specifications for scheduling requirements for this contract.

#### **IB-28 EQUAL EMPLOYMENT OPPORTUNITY**

1. Article III, Division 2 of Chapter 28 applies to this contract. It is the policy of the City to provide equal opportunity in employment without regard to race, color, creed, sex, national origin, religion, marital status, or political opinion or affiliation. It is hereby deemed and declared to be for the public welfare and in the best interest of the City to require bidders, contractors and subcontractors soliciting and receiving, directly or indirectly, compensation from or through the City, for the performance of such contracts, to meet certain affirmative action and equal employment opportunity requirements. Additionally, contractors and subcontractors that hold any contracts which are federally-assisted shall be required to adhere to the Department of Labor's Contract Compliance program under Executive Order 11246 as defined in the regulations of the Secretary of Labor at 41 CFR Chapter 60-4.
2. After the Execution of the Contract, the Contractor shall submit the following to the Division of Small Business Opportunity:
  - (a) A statement that the Contractor shall implement the affirmative action steps set forth in the Rules and Regulations and Proposal Conditions of the Manager of Public Works pertaining to Equal Employment Opportunity, attached hereto, or the Contractor's affirmative action plan which meets these requirements, and
  - (b) A projection of its anticipated workforce for this contract on the attached "EEO Questionnaire." Both of these submittals are required before the Division of Small Business Opportunity will approve the Notice to Proceed.
3. The Contractor which is awarded this contract shall comply with the provisions and requirements, including the goals of minority and female participation and specific affirmative action steps, set forth in the Rules and Regulations and Proposal Conditions of the Manager of Public Works pertaining to Equal Employment Opportunity, as said rules and regulations may be amended or readopted from time

to time by the Manager of Public Works or the Director of the Division of Small Business Opportunity.

#### **IB-29 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION**

The Contractor certifies, by submission of its Proposal or acceptance of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or involuntarily excluded from participation in any government contract by any Federal, State, or local government department or agency. It further agrees by submitting its Proposal that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the Contractor or any lower tier participant is unable to certify to this statement, it shall attach an explanation to its Task Order.

#### **IB-30 INSURANCE REQUIREMENTS AND SAFETY MANUAL**

Contractor shall assure at Contract Execution that insurance requirements contained in the Contract Documents are met. In accordance with the provisions of General Contract Condition 1601, INSURANCE, the minimum insurance requirements for this Contract are set forth in the form **CITY AND COUNTY OF DENVER INSURANCE CERTIFICATE** contained in the Special Conditions Section of the Contract Documents. Contractors are urged to consider in preparing a Task Order hereunder that the Contractor and all subcontractors performing Work on the Project must comply with each condition, requirement or specification set forth in the form certificate, unless such requirements are specifically accepted in writing by the City's Risk Management Administrator. The Contractor must either include all subcontractors performing work hereunder as insureds under each required policy or furnish a separate certificate (on the form certificate provided) for each subcontractor.

All certificates required by this Contract shall be sent directly to Denver International Airport, Business Management Services, via the following email address: [ContractAdminInvoices@flydenver.com](mailto:ContractAdminInvoices@flydenver.com) The City project/Contract number and project description shall be noted on the certificate of insurance. The City reserves the right to require complete, certified copies of all insurance policies required by this Contract at any time.

#### **IB-31 INVOICING**

The Contractor recognizes and agrees that it shall be required to use the Textura® Construction Payment Management System (CPM System) for this Project.

All fees associated with the CPM System are to be paid by the Contractor prior to billings for any work performed (the "Textura Fee"). **The Textura fee shall be included as a line item in the Contractors Schedule of Values per Task Order.**

During the negotiation phase the City will work with Textura to calculate the Textura

fee as a percentage of the sub-total of all other line items. The City will provide the Textura Fee amount to the Contractor, who will then pay this amount to Textura directly. The Textura Fee should be included on a Contractors pay application to the City and the City will reimburse the Contractor as a pass-through expense for the Textura Fee with no mark-up.

The attached Textura Fee Schedule, included in the Proposal documents, is only to be used as a reference.

Effective January 2018, Textura will be moving to a flat fee schedule as attached. Fees paid by Prime with no mark up, and subsequently reimbursed by the City, will no longer be calculated as a percentage of a task/contract amount but will instead be a flat amount.

### **IB-32 PROJECT CONTROLS REQUIREMENTS**

The Contractor will be required to use the designated Project Management Information System (PMIS) as set forth in the Technical Specifications. The PMIS is Airport Infrastructure Management's tool for project and information management, data analysis and document control. Denver International Airport will be responsible for providing the licensing and training for PMIS.

**EEO QUESTIONNAIRE**  
**Contract No.: 201734681**

1. Name of Business: \_\_\_\_\_
2. Address: \_\_\_\_\_
3. City, State, Zip Code: \_\_\_\_\_
4. Telephone Number: (\_\_\_\_\_) \_\_\_\_\_
5. Name and title of your firm's EEO Contact: \_\_\_\_\_
6. Are you an affiliate or a subsidiary of another business organization (branches, etc.)?  
 Yes  No
7. Type of business you are engaged in: \_\_\_\_\_
8. Does the organization have a procedure for resolving discrimination complaints?  
 Yes  No
9. Has your firm been charged with discrimination within the past eighteen (18) months?  
 Yes  No
10. Is your firm required to submit an EEO-1 annually to the EEOC?  
 Yes  No
11. Are you now working or have you worked on a City and County of Denver contract during the past twelve (12) months?  Yes  No  
 If yes, complete the following information:

<u>Type of Contract</u>	<u>Contract Number</u>	<u>Total Cost of Each Contract</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

(You may use additional sheets if necessary)

**PROJECTION OF ANTICIPATED WORKFORCE**  
**Contract No. 201734681**

12. List the number of anticipated new employees needed by the contractor to perform this contract by trade/craft positions.

**ANTICIPATED NUMBER OF NEW EMPLOYEES FOR THIS CONTRACT**

Trade Craft	Estimated Total Manpower	Estimated Total Hours	Number of Employees Minority/Female	Total Estimated Employees Minority/Female
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

13. What is the anticipated number of employees from the Contractor's current work force to be utilized to perform this contract? \_\_\_\_\_

14. Estimate manpower utilization for the project below:

**ESTIMATE OF MANPOWER UTILIZATION**

Trade Craft	Estimated Total Manpower	Estimated Total Hours	Number of Employees Minority/Female	Total Estimated Employees Minority/Female
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

15. Will the estimated total manpower (anticipated new hires and current staff to be utilized on this contract) meet the City's minority employment and female employment goals?

Yes  No

# DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS

In order for the agency or City to consider the Task Order or proposal, Contractors must complete the electronic version of the Diversity And Inclusiveness In City Solicitations Form then **print the completed form and include the hard copy as part of its Task Order documents. A proposal or response to a solicitation by a contractor/consultant that does not include this completed form shall be deemed non-responsive and rejected.** The form is found at: <https://fs7.formsite.com/CCDenver/form161/index.html>

Using the form found in link listed above, please state whether you have a Diversity and Inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the Diversity and Inclusiveness in City Solicitations Information Request Form will provide an opportunity for City contractors/consultants to describe their own diversity and inclusiveness practices. Contractors/consultants are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor/consultant's current practices, if any. Diversity and Inclusiveness information provided by City contractors/consultants in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable information provided by or obtained from contractors/consultants will be in such reports.

**Insert the completed hard copy of the Diversity And Inclusiveness  
In City Solicitations Form immediately following this page.**

**A SIGNED HARD COPY OF THE COMPLETED FORM MUST  
BE INCLUDED IN YOUR TASK ORDER RESPONSE**

Contractor \_\_\_\_\_

**DENVER INTERNATIONAL AIRPORT**

**Conveyance Replacement & Modernization  
Contract No.201734681**

**Task Order Data Forms  
EQUAL OPPORTUNITY REPORT STATEMENT**

Each Contractor shall complete and sign the Equal Opportunity Report Statement. A Task Order may be considered unresponsive and may be rejected, in the Owner's sole discretion, if the Contractor fails to provide the fully executed Statement or fails to furnish required data. The Contractor shall also, prior to award, furnish such other pertinent information regarding its own employment policies and practices as well as those of its proposed subcontractors as the FAA, the Owner, or the Executive Vice Chairman of the President's Committee may require.

The Contractor shall furnish similar Statements executed by each of its first-tier and second-tier subcontractors and shall obtain similar compliance by such subcontractors, before awarding subcontracts. No subcontract shall be awarded to any non-complying subcontractor.

Equal Opportunity Report Statement  
as Required in 41 CFR 60-1.7(b)

The Contractor shall complete the following statements by checking the appropriate blanks. Failure to complete these blanks may be grounds for rejection of the Proposal:

1. The Contractor has \_\_\_ has not \_\_\_ developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-1.40 and 41 CFR 60-2.
2. The Contractor has \_\_\_ has not \_\_\_ participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 11246, as amended.
3. The Contractor has \_\_\_ has not \_\_\_ filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).
4. The Contractor does \_\_\_ does not \_\_\_ employ fifty or more employees.

Dated: \_\_\_\_\_

\_\_\_\_\_  
(Name of Contractor)

By: \_\_\_\_\_

Title: \_\_\_\_\_

Contractor \_\_\_\_\_

**DENVER INTERNATIONAL AIRPORT**

**Conveyance Replacement & Modernization  
Contract No.201734681  
Task Order Data Forms**

**CERTIFICATION OF NON-SEGREGATED FACILITIES  
(Must be completed and submitted with the Contract)**

The Contractor certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The Contractor certifies further that it will not maintain or provide for its employees segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The Contractor agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or any other reason. The Contractor agrees that (except where it has obtained identical certification from proposed subcontractors for specific time period) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the equal opportunity clause, and that it will retain such certification in its files.

DATED: \_\_\_\_\_

\_\_\_\_\_  
(Name of Contractor)

By: \_\_\_\_\_

Title: \_\_\_\_\_



## TEXTURA - CPM FEES - DENVER / DEN

	PROJECT SIZE	FEE (% OF TASK ORDER)
<b>A</b>	<b>&lt; \$1,000,000</b>	<b>0.0022</b>
<b>B</b>	<b>\$1,000,001 - \$5,000,000</b>	<b>0.0017</b>
<b>C</b>	<b>\$5,000,001 - \$20,000,000</b>	<b>0.0012</b>
<b>D</b>	<b>\$20,000,001 - \$50,000,000</b>	<b>0.0010</b>
<b>E</b>	<b>\$50,000,001 - \$100,000,000</b>	<b>0.0008</b>
<b>F</b>	<b>\$100,000,001 - \$500,000,000</b>	<b>0.0005</b>
<b>G</b>	<b>&gt; \$500,000,000</b>	<b>*</b>

\* CONTACT TEXTURA FOR PROGRAMING PRICING

**EXAMPLES:**

<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;"><b>A</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$978,256.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0022</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$2,152.16</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;">\$980,408.</td> </tr> </table>	<b>A</b>	Sub Total	\$978,256.00		Fee (% of Task Order)	0.0022		Textura Fee	\$2,152.16		Total (Sub Total +Textura Fee)	\$980,408.	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;"><b>D</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$35,078,342.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0010</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$35,078.34</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;">\$35,113,420.34</td> </tr> </table>	<b>D</b>	Sub Total	\$35,078,342.00		Fee (% of Task Order)	0.0010		Textura Fee	\$35,078.34		Total (Sub Total +Textura Fee)	\$35,113,420.34
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<b>Total (Sub Total +Textura Fee)</b>	<b>\$19,023,747.14</b>	<b>Total (Sub Total +Textura Fee)</b>	<b>\$428,549,245.54</b>
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# W-9

**Please complete the Request for Taxpayer Identification Number  
and Certification (Form W-9) and submit with your Proposal.  
These pages are not included in the page numbering of this contract document.**

# **DSBO FORMS**

**The DSBO forms which apply to this contract are contained in the pages immediately following this page. These pages are not included in the numbering of this contract document.**

# PREVAILING WAGES

# **CONTRACT**

**The contract is contained in the pages immediately following this page  
which include the following attachments:**

**These pages are not included in the page numbering of this contract document.**

## CONTRACT

**THIS CONTRACT**, made and entered into as of the date indicated on the City signature page below, by and between the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado, hereinafter referred to as the "**CITY**", and **THYSSENKRUPP ELEVATOR CORPORATION**, a corporation organized and existing under and by virtue of the laws of the State of Georgia and authorized to work in Colorado, hereinafter referred to as the "**CONTRACTOR**";

## WITNESSETH

**WHEREAS**, the City, for at least three (3) consecutive days, advertised that sealed proposals would be received for furnishing all labor, tools, supplies, equipment, materials and everything necessary and required for the construction and installation of task orders issued under Contract No. **2017346810, ON-CALL CONSTRUCTION SERVICES 2017**, Denver International Airport; and

**WHEREAS**, proposals to said advertisement have been received by the Chief Executive Officer Department of Aviation, who has recommended that a contract for said work be made and entered into with the above named Contractor who was the best, responsive, qualified proposer therefore; and

**WHEREAS**, said Contractor is now willing and able to perform all of said work in accordance with the Contract Documents and its proposal;

**NOW, THEREFORE**, for and in consideration of the compensation to be paid the Contractor, the mutual agreements hereinafter contained, and subject to the terms hereinafter stated, it is mutually agreed as follows:

**ARTICLE I - CONTRACT DOCUMENTS**: It is agreed by the parties hereto that the following list of instruments, drawings and documents which are attached hereto and bound herewith or incorporated herein by reference constitute and shall be referred to either as the Contract Documents or the Contract, and all of said instruments, drawings and documents taken together as a whole constitute the Contract between the parties hereto, and they are as fully a part of this agreement as if they were set out verbatim and in full herein:

- Notice to Apparent Selected Proposer (incorporated by reference)
- Contract
- Exhibit A – Compliance Plan
- Exhibit B - Payment & Performance Bond
- Exhibit C - Notice to Proceed
- Exhibit D - Form of Final Receipt
- Exhibit E - Construction Contract General Conditions (table of contents attached)
- Exhibit F - Special Conditions
- Exhibit G - Prevailing Wage Schedules
- Exhibit H - Insurance requirements

Exhibit I - Equal Employment Opportunity Provisions  
Technical Specifications (to be provided and incorporated per task order)  
Contract Drawings (to be provided and incorporated per task order)  
Approved Shop Drawings (to be provided and incorporated per task order)  
Approved Task Orders  
Approved Task Order Directives  
Approved Change Orders  
Approved Change Order Directives  
Task Notice for Proposal

**ARTICLE II - SCOPE OF WORK:** The Contractor agrees to and shall furnish all labor and tools, supplies, equipment, superintendence, materials and everything necessary for and required to do, perform and complete all of the work described, drawn, set forth, shown and included in said Contract Documents.

**ARTICLE III - TERMS OF PERFORMANCE:** The Contractor agrees to begin the performance of the work required under this Contract within ten (10) days after being notified to commence work by the Senior Vice President – Airport Infrastructure Maintenance (“SVP”) and agrees to fully complete the Work in its entirety within the time frame established for each Task. The entire contract shall be complete no later than 1825 consecutive calendar days from the date of said Notice to Proceed. This period of performance is also referred to as Contract Time. The Contractor is not authorized to commence work prior to its receipt of the Notice to Proceed.

**ARTICLE IV - LIQUIDATED DAMAGES:** It is understood and agreed by and between the City and the Contractor that, if the Contractor fails to achieve Substantial Completion of the Work within the Contract Time or fails to substantially complete the Work described in a Milestone Area within the time set forth in the Special Conditions or causes Disruptions as set forth in the Special Conditions, the City will suffer substantial damages, which damages would be difficult to accurately determine. The parties hereto have considered the possible elements of damages and have agreed that the amount of liquidated damages for the Contractor's failure to substantially complete the work within the Contract Time or to substantially complete the work described in Milestone Areas within the time set forth in the Special Conditions or causes Disruptions as set forth in the Special Conditions shall be those amounts listed in the Special Conditions. If the Contractor shall fail to pay such liquidated damages promptly upon demand therefor, the Surety on its Performance Bond and Payment Bond shall pay such damages. Also, the City may withhold all, or any part of, such liquidated damages from any payment due the Contractor. Additional provisions relating to liquidated damages are set forth in the Construction Contract General Conditions and Special Conditions.

**ARTICLE V - TERMS OF PAYMENT:** The City agrees to pay the Contractor for the performance and completion of all of the Work required under each authorized Task Order, in accordance with the Contract Documents. In no event, however, shall the total amount of compensation paid to the Contractor by the City exceed the maximum contract amount specified herein.



The maximum amount to be paid by the City to the Contractor for satisfactory completion of all Task Orders authorized by the City and performed by the Contractor under this Contract shall in no event exceed **Ten Million Dollars and Zero Cents (\$10,000,000.00)**, unless the Contract is modified to increase said amount by a duly authorized, written contract amendment mutually agreeable to and executed by the parties hereto.

Payments will be made to the Contractor in accordance with the City's Prompt Payment Ordinance, D.R.M.C., Section 20-107, et. seq., subject to the maximum contract amount stated above. Contractor agrees that interest and late fees shall be payable by the City hereunder only to the extent authorized and provided for in the City's Prompt Payment Ordinance.

Payment hereunder will be in accordance with the provisions of the Contract Documents, including Title 9 of the General Conditions, and will be made solely and exclusively from funds appropriated and otherwise lawfully made available for the purposes of this Contract from the City and County of Denver Airport System, Operations and Maintenance and Capital Improvement funds. The City has no obligation to make payments from any other fund or source or to make additional appropriations or allocations to such fund to satisfy such costs or other obligations.

#### **ARTICLE VI - INSPECTION AND ACCEPTANCE:**

Contractor shall perform all services in accordance with the standard of care exercised by highly competent vendors who perform like or similar services. City may inspect all goods/services prior to acceptance. Payment does not constitute acceptance. Contractor shall bear the cost of any inspection/testing that reveal goods/services that are defective or do not meet specifications. City's failure to accept or reject goods/services shall not relieve Contractor from its responsibility for such goods/services that are defective or do not meet specifications nor impose liability on City for such goods/services. If any part of the goods/services are not acceptable to City, City may, in addition to any other rights it may have at law or in equity: (1) make a warranty claim; (2) repair and/or replace the goods or substitute other services at Contractor's expense; or (3) reject and return the goods at Contractor's cost and/or reject the services at Contractor's expense for full credit. Any rejected goods/services are not to be replaced without written authorization from City, and any such replacement shall be on the same terms and conditions contained in this Agreement.

**ARTICLE VII - DISPUTES:** It is agreed and understood by the parties hereto that disputes regarding this contract shall be resolved by administrative hearing under procedures described in Revised Municipal Code Section 5-17.

**ARTICLE VIII - RISK OF LOSS:** Contractor shall bear the risk of loss, injury or destruction of goods prior to delivery to City. Loss, injury or destruction shall not release Contractor from any obligation hereunder.

**ARTICLE IX - WARRANTY:** Contractor warrants and guarantees to City that all goods furnished under this Agreement are free from defects in workmanship and materials, are merchantable, and fit for the purposes for which they are to be used. For any goods furnished under this Agreement which become defective within 12 months (unless otherwise specified) after date of receipt and final acceptance by City, Contractor shall, at City's election and to City's satisfaction, 1. Replace any and all defective goods at no expense to City within seven (7) days of receipt of the defective goods or 2. Accept the defective goods for full credit and payment of any return shipping charges or 3. Accept a Contractor-provided written plan of repair commencement with time frames which would require approval by the City's Authorized Representative. Contractor shall provide a spare parts list that must be approved by the City. The cost of approved spare parts required shall be included in the base bid price. Spare parts shall be turned over at the completion of each work order. Contractor shall also be required to make two (2) on-site evaluations on the units during the 12-month period following the final acceptance by the City and such costs will be included in the overall pricing for each unit. Evaluation dates will be mutually agreed upon by the Parties. During the 12-month period, all maintenance and repairs will be covered by current DEN maintenance provider utilizing the spare parts and/or defective part replacements provided as noted above.

**ARTICLE X - CONTRACT BINDING:** It is agreed that this Contract shall be binding on and inure to the benefit of the parties hereto, their heirs, executors, administrators, assigns and successors.

**ARTICLE XI - SEVERABILITY:** If any part, portion or provision of this Contract shall be found or declared null, void, or unenforceable for any reason whatsoever by any court of competent jurisdiction or any governmental agency having authority thereover, only such part, portion, or provision shall be affected thereby and all other parts, portions and provisions of this Contract shall remain in full force and effect.

**ARTICLE X - ASSIGNMENT:** The Contractor shall not assign the whole or any part of its duties, rights, and interests in this Contract without first obtaining the written consent of the Manager.

**ARTICLE XII - APPROVALS:** In the event this Contract calls for the payment by the City of Five Million Dollars (\$5,000,000.00) or more, approval by the Board of Councilmen of the City and County of Denver, acting by Ordinance in accordance with Section 3.2.6 of the Charter of the City and County of Denver, is and shall be an express condition precedent to the lawful and binding execution and performance of this Contract.

**ARTICLE XIII - JOINT VENTURE:** If the Contractor is a Joint Venture, the partners to the Joint Venture shall be jointly and severally liable to the City for the performance of all duties and obligations of the Contractor which are set forth in the Contract.

**ARTICLE XIV - NO DISCRIMINATION IN EMPLOYMENT:** In connection with the performance of work under this Contract, the Contractor agrees not to refuse to hire, discharge, promote or demote, or to discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, gender, age, military status, sexual orientation, gender variance, marital status, or physical or mental disability; and the Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

**ARTICLE XV - WAIVER OF CRS 13-20-801, et seq.:** Notwithstanding any other provision of this Contract, the Contractor specifically waives all of the provisions of Colorado Revised Statutes §§ 13-20-801 – 80 as they may relate to the Contractor’s performance under this Contract.

**ARTICLE XVI - COORDINATION OF SERVICES:** The Contractor agrees to perform its work under this Contract in accordance with the operational requirements of DIA, and all work and movement of personnel or equipment on areas included within the DIA site shall be subject to the regulations and restrictions established by the City or its authorized agents.

**ARTICLE XVII - COMPLIANCE WITH ALL LAWS AND REGULATIONS:** All of the work performed under this Contract by the Consultant shall comply with all applicable laws, rules, regulations and codes of the United States and the State of Colorado, and with the charter, ordinances and rules and regulations of the City and County of Denver.

**ARTICLE XVIII – PROMPT PAY:** The Contractor is subject to D.R.M.C. Section 20-112 wherein the Contractor is to pay its subcontractors in a timely fashion. A payment is timely if it is mailed to the subcontractor no later than seven days after receipt of any payment from City. Any late payments are subject to a late payment penalty as provided for in the prompt pay ordinance (Section 20-107 through 20-118).

**ARTICLE XXIV – COLORADO OPEN RECORDS ACT:** The Contractor acknowledges that the City is subject to the provisions of the Colorado Open Records Act, Colorado Revised Statutes §24-72-201 et seq., and the Contractor agrees that it will fully cooperate with the City in the event of a request or lawsuit arising under such act for the disclosure of any materials or information which the Contractor asserts is confidential and exempt from disclosure. Any other provision of this Contract notwithstanding, including exhibits, attachments and other documents incorporated into this Contract by reference, all materials, records and information provided by the Contractor to the City shall be considered confidential by the City only to the extent provided in the Open Records Act, and the Contractor agrees that any disclosure of information by the City consistent with the provisions of the Open Records Act shall result in no liability of the City.

**ARTICLE XV – COMPLIANCE WITH MINORITY/WOMEN BUSINESS ENTERPRISE REQUIREMENTS:** This Contract is subject to all applicable provisions of Divisions 1 and 3 of Article III, of Chapter 28, Denver Revised Municipal Code (D.R.M.C.), designated as Sections 28-31 – 29-36 and 28-52 – 28-90 D.R.M.C. and referred to in this Contract as the “M/WBE Ordinance”. In accordance with the requirements of the M/WBE Ordinance, the Contractor is committed to, at a minimum, meet the participation goal of **Eight Percent (8%)** established for this Project utilizing properly certified M/WBE subcontractors and suppliers. In addition to the applicable provisions of the M/WBE Ordinance, the Contractor agrees, as an express condition of its performance hereunder, to comply with the requirements of any approved Small Business Enterprise Compliance Plan (attached and incorporated herein as **Exhibit A**). Such plan shall, at a minimum, include a narrative regarding compliance with the goal; a list of committed M/WBE participants along with dollar and percent participation for each evidencing compliance with the overall goal, and fully executed letters of intent for each listed participant, all in a form satisfactory to the City. Without limiting the general applicability of the foregoing, the Contractor

acknowledges its continuing duty, pursuant to Sections 28-72, 28-73 and 28-75 D.R.M.C. and the M/WBE Program, to meet and maintain throughout the duration of this Construction Contract its participation and compliance commitments and to ensure that all Subcontractors subject to the M/WBE Ordinance or the M/WBE Program also maintain such commitments and compliance. Failure to comply with these requirements may result, at the discretion of the Director of the Division of Small Business Opportunity (“DSBO”), in the imposition of sanctions against the Contractor in accordance with Section 28-77, D.R.M.C. Nothing contained in this Paragraph or in the referenced City ordinance shall negate the City’s right to prior approval of Subcontractors, or substitutes therefore, under this Construction Contract.

**ARTICLE XVI – ELECTRONIC SIGNATURES AND ELECTRONIC RECORDS:**

Contractor consents to the use of electronic signatures by the City. The Contract, and any other documents requiring a signature hereunder, may be signed electronically by the City in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Contract solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Contract in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

**[END OF PAGE]**

## EXHIBIT B

### PERFORMANCE BOND

**KNOW ALL MEN BY THESE PRESENTS**, that we, the undersigned \_\_\_\_\_  
[Contractor ], a corporation organized under the laws of the State of \_\_\_\_\_ [ Contractor\_state], hereinafter referred to as the "Contractor" and \_\_\_\_\_ [Bond issuer], a corporation organized under the laws of the State of \_\_\_\_\_ [Bond company state], and authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as the "CITY", in the penal sum of \_\_\_\_\_ [Task Order amount text] Dollars (\$\_\_\_\_\_), lawful money of the United States of America, for the payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators, successors and assigns, jointly and severally by these presents.

**WHEREAS**, the above Contractor has, as of the date of execution listed on the contract signature page, entered into a written contract with the City for furnishing all labor, materials, equipment, tools, superintendence, and other facilities and accessories for the construction of 201734681 Passenger Conveyance Modernization On-Call, Denver International Airport, in accordance with the Technical Specifications, Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and made a part hereof, and are herein referred to as the Contract.

**NOW, THEREFORE**, the condition of this performance bond is such that if the Contractor:

1. Promptly and faithfully observes, abides by and performs each and every covenant, condition and part of said Contract, including, but not limited to, its warranty provisions, in the time and manner prescribed in the Contract, and
2. Pays the City all losses, damages (liquidated or actual, including, but not limited to, damages caused by delays in the performance of the Contract), expenses, costs and attorneys' fees, that the City sustains resulting from any breach or default by the Contractor under the Contract, then this bond is void; otherwise, it shall remain in full force and effect.

**IN ADDITION**, if said Contractor fails to duly pay for any labor, materials, team hire, sustenance, provisions, provender, or any other supplies used or consumed by said Contractor or its subcontractors in its performance of the work contracted to be done or fails to pay any person who supplies rental machinery, tools, or equipment, all amounts due as the result of the use of such machinery, tools, or equipment in the prosecution of the work, the Surety shall pay the same in an amount not exceeding the amount of this obligation, together with interest as provided by law.

**PROVIDED FURTHER**, that the said Surety, for value received, hereby stipulates and agrees that any and all changes in the Contract or compliance or noncompliance with the formalities in the Contract for making such changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any such changes.

(End of Page)

**IN WITNESS WHEREOF**, said Contractor and said Surety have executed these presents as of this \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
CONTRACTOR

By: \_\_\_\_\_  
President

\_\_\_\_\_  
SURETY

By: \_\_\_\_\_  
Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

**CITY AND COUNTY OF DENVER**

By: \_\_\_\_\_  
MAYOR

By: \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

**APPROVED AS TO FORM:**

KRISTIN M. BRONSON, Attorney for the  
City and County of Denver

By: \_\_\_\_\_  
Assistant City Attorney

**PAYMENT BOND**

**KNOW ALL MEN BY THESE PRESENTS,** that we, the undersigned \_\_\_\_\_ [Contractor name], a corporation organized under the laws of the State of \_\_\_\_\_ [Contractor state], hereinafter referred to as the "Contractor" and \_\_\_\_\_ [Bonding company name], a corporation organized under the laws of the State of \_\_\_\_\_ [Bonding company state], and authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as the "CITY", in the penal sum of \_\_\_\_\_ [Proposal amount text] Dollars (\$ \_\_\_\_\_), lawful money of the United States of America, for the payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the above Contractor has entered into a written contract with the City for furnishing all labor, materials, tools, superintendence, and other facilities and accessories for the construction of Contract No. \_\_\_\_\_ Denver International Airport, in accordance with the Technical Specifications, Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and made a part hereof, and are herein referred to as the Contract.

**NOW, THEREFORE,** the condition of this payment bond obligation is such that if the Contractor shall at all times promptly make payments of all amounts lawfully due to all persons supplying or furnishing it or its subcontractors with labor and materials, rental machinery, tools, or equipment, used or performed in the prosecution of work provided for in the above Contract and shall indemnify and save harmless the City to the extent of any and all payments in connection with the carrying out of such Contract which the City may be required to make under the law, then this obligation shall be null and void, otherwise, it shall remain in full force and effect;

**PROVIDED FURTHER,** that the said Surety, for value received, hereby stipulates and agrees that any and all changes in the Contract, or compliance or noncompliance with the formalities in the Contract for making such changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any such changes.

[END OF PAGE]

**IN WITNESS WHEREOF**, said Contractor and said Surety have executed these presents as of this \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
CONTRACTOR

By: \_\_\_\_\_  
President

\_\_\_\_\_  
SURETY

By: \_\_\_\_\_  
Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

CITY AND COUNTY OF DENVER

By: \_\_\_\_\_  
MAYOR

By: \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

APPROVED AS TO FORM:

KRISTIN M. BRONSON, Attorney for the  
City and County of Denver

By: \_\_\_\_\_  
Assistant City Attorney



**EXHIBIT C**  
**CITY AND COUNTY OF DENVER**  
**DEPARTMENT OF AVIATION**

\*\*\*\*\*

**NOTICE TO PROCEED**

Date:

TO: [Contractor name and address]

You are hereby authorized and directed to proceed on this date with the work of constructing Contract No. 201734681, Passenger Conveyance Modernization On-Call, Denver International Airport, Denver, Colorado, as set forth in detail in the Contract Documents for the City and County of Denver.

CITY AND COUNTY OF DENVER

By \_\_\_\_\_  
Senior Vice President  
Airport Infrastructure Management

By \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

**City and County of Denver**



**DENVER**  
THE MILE HIGH CITY

DEPARTMENT OF AVIATION  
DEPARTMENT OF PUBLIC WORKS

**STANDARD SPECIFICATIONS FOR  
CONSTRUCTION  
GENERAL CONTRACT CONDITIONS**

2011 Edition

**Statement**

The City and County of Denver does not warrant or represent the accuracy or timeliness of the information contained in this page or any of its constituent pages and the information presented is for instructional purposes and illustration only and is not intended to be specific advice, legal or otherwise. The City has made every effort to provide accurate up-to-date information, however this database is dynamic and errors can occur. The City and County of Denver shall not be held responsible for errors or omissions nor be liable for any special consequential or exemplary damages resulting, in whole or in part, from any viewer(s)' uses of, or in reliance upon, this material.

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## EXHIBIT F

### SPECIAL CONDITIONS

#### SC-1 CONSTRUCTION CONTRACT GENERAL CONDITIONS

The Construction Contract General Conditions which constitute a part of the Contract Documents are set forth in a separately published document, entitled "City and County of Denver, Department of Aviation and Department of Public Works, Standard Specifications for Construction, General Contract Conditions," 2011 Edition, the Table of Contents to which is bound herein (which may be informally referred to as the Yellow Book). The General Conditions book is available for purchase for \$12.00 per copy at the following locations during the business hours stated, Monday through Friday, excluding holidays:

Office of the Cashier  
Wellington E. Webb Municipal Office Building, 2nd Floor  
201 West Colfax Avenue  
Denver, Colorado, USA 80202  
7:30 a.m. to 4:30 p.m.

The General Conditions are also available on the DEN Contract Procurement on the City and County of Denver website at:

<https://www.denvergov.org/content/dam/denvergov/Portals/743/documents/2011%20DENVER%20GENERAL%20CONTRACT%20CONDITIONS.pdf>

#### SC-2 DRAWINGS AND SPECIFICATIONS TO BE FURNISHED BY THE CITY

The City will provide the following Contract Documents to the Contractor in electronic format at no expense to the Contractor:

Document

Volumes 1 & 2 (See the Master Table of Contents, page TOC-3, for the content of these volumes)  
Contract Drawings

Additional copies of the foregoing documents will be furnished to the Contractor at the Contractor's expense. The Contractor will be responsible for supplying all subcontractors with copies of the Contract Documents at its expense.

If Sensitive Security Information ("SSI") is provided to the Contractor, the Contractor shall be required to comply with Department of Aviation, Standard Policies and Procedures No. 6003, "Contractor Protection of Sensitive Security Information," or its successor, and 49 C.F.R. § 1520, or its successor.

The City will not supply any copies of the General Contract Conditions to the Contractor at City expense.

#### SC-3 REVISIONS TO G.C. 201

The second sentence of General Condition 201 is amended to read: "The unit responsible for this

management and control is the Airport Infrastructure Management Office under the supervision of the Senior Vice President for Maintenance and Airport Infrastructure Management.”

#### **SC-4 CITY LINE OF AUTHORITY AND CONTACTS**

In accordance with General Condition 214, the City’s line of authority for administration of this Contract is:

Chief Executive Officer (CEO). Executive Office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249. Any reference to the Manager of Aviation shall also mean Chief Executive Officer, Department of Aviation (CEO).

Executive Vice President – Chief Operating Officer (EVP-COO) who reports to the CEO. Airport Infrastructure Management office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Senior Vice President - Airport Infrastructure Management (SVP-AIM) who reports to the COO. Airport Infrastructure Management office, 10th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Director of Infrastructure and Quality Assurance, reports to the SVP-AIM. The Project Manager reports to the Director of Infrastructure and Quality Assurance. Airport Infrastructure Management Division, 7<sup>th</sup> Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Project Manager, the City representative who has day to day administrative responsibility of this Contract, and who reports to the SVP-AIM. All notices, requests, pay applications (pursuant to G.C. 902), and other correspondence from the Contractor shall be sent to the assigned Project Manager unless otherwise provided in this Contract. The Project Manager for this Contract is: Joshua Spoon, Airport Infrastructure Management Office, 7th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249, phone 303-342-2200.

The CEO may from time to time substitute a different City official as the designated “SVP-AIM” hereunder, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor SVP-AIM. The SVP-AIM may from time to time change the assigned Project Manager, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor Project Manager.

#### **SC-5 CONTRACTOR PERFORMANCE; SUBCONTRACTING**

With respect to General Condition 501, no more than ninety-five percent (95%) of the work may be subcontracted. If it is determined to be in the City’s best interest, this percentage may be modified throughout the course of the project by the SVP-AIM.

#### **SC-6 COOPERATION WITH OTHERS**

The Technical Specifications describe the constraints on the physical work site areas. These descriptions are not exhaustive and the Contractor is required to coordinate its activities and work as may be required to meet FAA or City requirements while performing work on DEN.



Without limiting the foregoing, the following contracts administered by the City involve or may involve work overlapping or adjoining the Work under this Contract, and may be prosecuted concurrently with the Work performed under this Contract. There may also be other adjoining or overlapping contracts which are not listed.

**SC-7 PROSECUTION AND COMPLETION OF THE WORK:**

The Work to be performed under the Contract is described in the Technical Specifications and Contract Drawings. The Contractor shall complete the Work within 1825 consecutive calendar days from Notice to Proceed.

The Work to be performed under the Contract may be divided into the Milestone Areas which are described in the Technical Specifications or Contract Drawings. The Contractor shall complete the work included within these areas within the number of days set forth by the Project Manager.

**SC-8 LIQUIDATED DAMAGES**

If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, the Contractor shall be liable to the City for liquidated damages at the rate of Two Thousand Dollars (\$2,000.00) per day until substantial completion is achieved.

Article IV of the Contract and General Condition 602 cover payment and withholding of liquidated damages.

**SC-9 FACILITY SECURITY AND PERSONNEL ACCESS**

The Contractor shall conduct all its activities at the Airport in compliance with the Airport security system rules and regulations, which are administered by the Airport Operations Division. The Contractor shall obtain the proper access authorizations for its employees, subcontractors and suppliers (i.e., Badges and Permits), and shall be responsible for such persons' compliance with all the Airport rules and regulations. A copy of the Contractors' section of the Airport Security rules and regulations are available for Contractor review at the Airport Access Services Office, Concourse A East Subcore, 4th Level. Persons regularly entering the construction areas must obtain personnel access badges from the Airport Access Services Office and must display badges, at all times, upon entering the construction, restricted and sterile areas of the airport.. Any employee, subcontractor or supplier who violates such rules may be subject to revocation of his access authorization, including authorization for access to the construction site and all other restricted and sterile areas.

The security status of the Airport is subject to change without notice. These contract Special Conditions are applicable to the current security status of the Airport. Should the security status of the Airport change at any time during the term of this Contract, a written notice shall be issued to the Contractor detailing all applicable security modifications from the airport's current security status. The Contractor shall take **immediate steps** to comply with those security modifications as directed in the written notice.

If these security modifications involve any additional project cost, the Contractor shall submit a Contractor Change Request in accordance with the General Conditions for the additional cost. The Contractor Change Request shall outline in specific detail the effects of the security modifications on the

Contractor's performance of the Contract, and shall provide a detailed cost breakdown for each item for which the Contractor is requesting reimbursement.

The Contractor shall return to the City, at contract completion or termination, or upon demand by the City, all access keys issued to it by the City to all areas of the Airport. If the Contractor fails to return any such key or keys at contract completion or termination or upon demand by the City, the Contractor shall be liable to the City for all the City's costs, including the City's labor costs for employees, incurred in re-coring doors and any other work which is required to prevent compromise of the Airport security system. In order to collect such costs hereunder, the City may withhold funds in such amount from any amounts due and payable to the Contractor under this Contract.

The construction of all the Project / Task Items that involve the breaching of any airport perimeter security boundary or continued access to restricted access rooms or areas will require the posting of authorized contract security personnel to maintain required security controls. The Contractor's **Guarantee Maximum Price / Total Contract BID Amount / Task Order Proposal** shall include the cost of providing security services to maintain control and supervision of any and all airport perimeter security boundary breaches and for the duration of work activities where access to restricted areas is required and until the airport perimeter security boundaries are reestablished.

When security boundaries are opened for any reason, the Contractor must maintain one hundred percent (100%) control and supervision for the entire time that the openings are present to prevent unauthorized access to the secure / restricted access areas.

**THE IMPORTANCE OF THIS SPECIAL CONDITION CANNOT BE OVER-EMPHASIZED. SEVERE FINANCIAL PENALTIES AS WELL AS CONTRACT TERMINATION COULD RESULT IF AIRPORT PERIMETER SECURITY REQUIREMENTS ARE NOT STRICTLY FOLLOWED. THE REQUIREMENT TO PROVIDE ONE HUNDRED PERCENT (100%) CONTROL AND SUPERVISION OF BREACHES IN THE AIRPORT'S PERIMETER SECURITY BOUNDARY IS ABSOLUTE. AT NO TIME, DURING WORK AND NON-WORK HOURS SHALL ANY BREACHES IN THE AIRPORT'S SECURITY PERIMETER BE UNSUPERVISED AND / OR UNSECURED.**

For off-hours of construction, the Contractor may choose to erect a temporary wall to close all perimeter openings. The wall construction shall be of sufficient materials and strength to prevent access to the airport's Sterile/Restricted Areas. The Contractor shall submit for review and approval, the details and materials for the temporary closure of security perimeter breaches for review and approval.

The Contractor will provide contract security guard services to maintain supervision of these openings. The security services must provide coverage to allow for lunch breaks, comfort breaks and etc. The security services **must** be obtained from the following contract security guard company:

HSS  
900 S. Broadway, Suite 100  
Denver, Colorado 80209

DEN Contact: Glenn Spies  
(303) 342-4323

All security guards provided for this project must have a Denver Airport SIDA Badge.

The DEN Security Guard Contractor may change between the bidding or proposal phase of this contract from Notice to Proceed to closure of all security perimeter breaches. The Contractor shall maintain a contractual relationship with the Security Guard Contractor holding the most current contract with Denver International Airport.

The Contractor shall continue to provide security of these areas until such time that the breaches in the airport's security perimeter have been permanently secured.

The Contractor shall submit a written security plan for approval to the Director of Airport Security prior to the start of construction on any work where a breach of the perimeter security boundaries is required.

### **SC-10 CONSTRUCTION ACCESS**

The work site is located at 26920 E. 86<sup>th</sup> Avenue, Denver, CO 80249. The Contractor shall have access to the work site via Airport Office Building (AOB) Gate, with all equipment and materials delivery routes TBD.

The City will not provide parking spaces for the Contractor's employees or subcontractor employees at the Airport. Arrangements for transportation and parking for all of its and its subcontractors employees will be the responsibility of the Contractor. The Total Contract Bid Amount or Contract Amount shall include any and all costs associated with the Contractor's and subcontractors' employee parking. Information about parking facilities and charges is available from the Airport Parking Office. Refundable deposits are required for all parking passes.

Unless specifically required by the Contract Documents, the Contractor shall install no fences or other physical obstructions on or around any project work area without the approval of the City.

### **SC-11 VEHICLE PERMITTING**

Vehicle access on the Airport Operation Area ("AOA") is controlled by and requires permission from the Airport Access Services Office. It is not anticipated that the Contractor will need to operate vehicles on the AOA to perform the Work. Only direct construction support vehicles and/or equipment will be allowed in the contractor's work areas or sites.

### **SC-12 VENDORS AND SUPPLIERS**

The Contractor shall provide the Project Manager's office with a list of its equipment/material vendors and suppliers. Vendors or suppliers shall access the construction work areas via the Contractor's access route, described in SC-10 above. All delivery vehicles are subject to search.

### **SC-13 COMMUNICATION DEVICES**

Any site communications devices, mobile communication devices or internet data devices used at DEN must be approved by DEN Technologies.

#### **SC-14 USE, POSSESSION OR SALE OF ALCOHOL OR DRUGS**

The Contractor and its officers, agents, and employees shall cooperate and comply with the provisions of Executive Order No. 94 and Attachment A thereto concerning the use, possession, or sale of alcohol or drugs. Violation of these provisions or refusal to cooperate with implementation of the policy can result in the City's barring the Contractor from City facilities or participating in City operations.

#### **SC-15 ATTORNEY'S FEES**

Colorado Revised Statute 38-26-107 requires that in the event any person or company files a verified statement of amounts due and unpaid in connection with a claim for labor and materials supplied on this project, the City shall withhold from payments to the Contractor sufficient funds to insure the payment of any such claims. Should the City and County of Denver be made a party to any lawsuit to enforce such unpaid claims or any lawsuit arising out of or relating to such withheld funds, Contractor agrees to pay to the City its costs and a reasonable attorney's fee. Because the City Attorney Staff does not bill the City for legal services on an hourly basis, Contractor agrees a reasonable fee shall be computed at the rate of one hundred dollars per hour of City Attorney time.

#### **SC-16 INSURANCE REQUIREMENTS**

In accordance with the provisions of Title 16 of the General Conditions, the minimum insurance requirements for this contract are set forth in the Exhibit H, attached to this Contract. The Contractor specifically agrees to comply with each condition, requirement or specification set forth in the attachment for each required coverage during all periods when the required coverage's are in effect.

Contractor and sub-contractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this Contract are satisfied, required insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or sub-contractors.

The insurance requirements herein are minimum requirements for this Contract and in no way limit the indemnity covenants contained in this Contract.

The City and County of Denver in no way warrants that the minimum limits contained herein are sufficient to protect the Contractor from liabilities that might arise out of the performance of the work under this Contract by the Contractor, his agents, representatives, employees or sub-contractors. The Contractor shall assess its own risks as it deems appropriate and/or prudent, maintain higher limits and/or broader coverages. The Contractor is not relieved of any liability or other obligations assumed or pursuant to the Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration or types.

Contractor shall furnish the City and County of Denver with certificates of insurance (ACORD form or equivalent approved by CCD) as required by this Contract. The certificates for each insurance policy are to be signed by a person authorized by the insurer to bind coverage on its behalf.

All certificates and any required endorsements are to be received and approved by the City before work

commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract or to provide evidence of renewal is a material breach of the Contract. All insurance coverages for sub-contractors shall be subject to the minimum requirements identified in the Exhibit. All sub-contractors certificates and endorsements shall be received and approved by the Contractor before work commences. The City reserves the right to request copies of these certificates at any time.

All certificates required by this Contract shall be sent directly to Denver International Airport, Business Management Services, Airport Office Building, Room 8810, 8500 Pena Boulevard, Denver, Colorado 80249. The City project/Contract number and project description shall be noted on the certificate of insurance. The City reserves the right to require complete, certified copies of all insurance policies required by this Contract at any time.

The parties hereto understand and agree that the City and County of Denver, its officers, officials and employees, are relying on, and do not waive or intend to waive by any provisions of this Contract, the monetary limitations or any other rights, immunities and protections provided by the Colorado Governmental Immunity Act, §§ 24-10-101 - 120, C.R.S., or otherwise available to the City and County of Denver, its officers, officials and employees.

#### **SC-17 SUBCONTRACTOR RELEASES**

The release form referred to in General Condition 907 is attached to this Contract. It is entitled "Denver International Airport Partial Release."

#### **SC-18 ADDITIONAL AFFIRMATIVE ACTION REQUIREMENTS, FEDERAL PROVISIONS**

This contract is subject and subordinate to the terms, reservations, restrictions, and conditions of any existing or future agreements between the City and the United States, the execution of which has been or may be required as a condition precedent to the transfer of federal rights or property to the City for airport purposes, and the expenditure of federal funds for airport purposes. The "Federal Requirements" section attached hereto is made a part of this Contract.

#### **SC-19 ESTIMATED QUANTITIES OF UNIT PRICED ITEMS**

The "total estimated quantity" of each unit price item as stated on the bid schedules shall be the estimated quantity which is used to determine the percentage of change in such item for purposes of G.C. 1104.7.

#### **SC-20 REVISIONS TO G.C. 1102**

G.C. 1102.2 is amended by replacing the phrase "Change Request" in all its occurrences in such G.C. with the phrase "Change Notice."

G.C. 1102.3 is amended by replacing the phrase "Field Order/Change Order Directive" in all its occurrences in such G.C. with the phrase "Change Order Directive."

## **SC-21 LISTING OF ACCEPTABLE MANUFACTURERS**

The Technical Specifications list “Acceptable Manufacturers” for certain products. Such listing identifies manufacturers of certain products which have been determined by a preliminary review to be able to meet the basic product and/or system technical requirements. The listing is not intended to provide a blanket endorsement or acceptance of the manufacturer’s specified products or product line. All products from listed manufacturers must meet the detailed requirements of the Technical Specifications. Products that do not meet all detailed Technical Specifications are not acceptable and will be rejected, regardless of whether the manufacturer was listed as “acceptable.” The Contractor is responsible for determining the acceptability of all products under the Technical Specifications prior to submission of products for approval.

## **SC-22 ACCESSIBLE PARKING SPACES, ACCESS AISLES AND ROUTES OF TRAVEL**

If any Work is performed in or adjacent to parking facilities at the Airport, the Contractor is responsible for compliance with this SC-30. “Accessible” parking spaces and access aisles as used in this SC-30 mean parking spaces and access aisles which are accessible for, and reserved for use by, persons with disabilities. These parking spaces and access aisles are designed and built to standards established by federal regulations implementing the Americans with Disabilities Act of 1990 (“ADA”), and are marked by signage. “Accessible routes of travel” as used herein means routes through parking facilities which comply with ADA accessibility standards, including degree of slope and absence of obstructions.

Accessible routes of travel and accessible parking spaces and access aisles must be kept free of obstructions and construction debris at all times. No accessible parking spaces or access aisles or accessible routes of travel shall be relocated, blocked or rendered unusable unless the contractor has obtained specific advance approval in writing for such actions from the airport’s ADA Compliance Officer.

When prosecution of the Work requires that accessible spaces be temporarily blocked, those accessible spaces and their access aisles shall be temporarily relocated to another location as close as possible to an accessible building entrance. Temporary signage that identifies these parking spaces and access aisles as reserved for the handicapped shall be installed, and the accessible route shall be clearly marked as required.

Before blocking or relocating accessible parking spaces or accessible routes of travel, the contractor must obtain written approval from the DEN ADA Compliance Officer, by submitting a completed request form, which will be provided to the Contractor by the Project Manager at the preconstruction meeting if it is not included as a standard form in Section 019990 of the Technical Specifications. The request shall include the location of alternative spaces and/or routes, and specifications of the temporary signage to be used. Work shall not proceed without this approval.

If a vehicle is parked in any accessible space which is either temporary or approved to be relocated, the contractor will not remove signage or take any other action which would allow the access aisle for such parking space to be blocked. Such actions must be postponed until the parking space is no longer occupied.

## **SC-23 SUBCONTRACTOR PAYMENTS AND SUBCONTRACTOR RELEASES – REQUIRED USE OF THE B2G CONTRACT MANAGEMENT SYSTEM**

The Contractor is required to use the City B2G Contract Management System to report all subcontractor payments and shall adhere to the City's Procedure for Reporting Subcontractor Payments. It is the Contractor's obligation to ensure that complete subcontractor information is entered into the B2G System prior to submission of the first application for payment in order to avoid any delays in payment. The Contractor shall, prior to the submission of each subsequent invoice, ensure payments to subcontractors have been entered into the B2G System, including subcontractor confirmation of amount of payment received, for services performed during the prior billing period.

**SC-24 PAYMENTS TO CONTRACTORS**

The Contractor recognizes and agrees that applications for payment shall be submitted using the Textura® Construction Payment Management System (CPM System), which will also be the payment mechanism to disburse payments to sub-contractors used on this Project. For more information, please refer to Division I, Technical Specifications.

The Contractor further agrees that, to the fullest possible within the CPM System, the City shall be entitled to all non-Confidential records, reports, data and other information related to the project that are available to Contractor through the CPM System, including, but not limited to, information related to Contractor and subcontractor billings. To that end, Contractor agrees that it will activate any available settings within the CPM System that are necessary to grant the City access to such non-Confidential information related to the contract and the project. Applications for payment shall be based on the Contract Unit Prices or the approved Schedule of Values described in GC 903.1

In accordance with General Contract Condition 902, PAYMENT PROCEDURE, The party(ies) responsible for review of all Pay Applications shall be:

**Agency/Firm**  
DEN Division CA  
DEN Division PM  
DEN Division Director  
DEN Contract Svcs CA  
CCD Denver Prevailing Wage

In accordance with General Contract Condition 906, APPLICATIONS FOR PAYMENT, each Application submitted shall include the following:

1. The estimate of Work completed shall be based on the approved schedule of values or unit prices, as applicable, and the percent of the Work complete.
2. Each Application for Payment shall include each and every independent subcontractor's payroll information including pay dates and pay amounts.
3. The Contractor shall also submit to the Auditor and other appropriate officials of the City in a timely fashion, information required by General Contract Condition 1004, REPORTING WAGES PAID.

In accordance with General Contract condition 907, RELEASES AND CONTRACTORS CERTIFICATION OF PAYMENT, applications for Payment must be accompanied by completed Partial or Final Claim Release Form, as appropriate, from EACH subcontractor and supplier, **AND** the Contractor's Certification of Payment Form.

# **INSURANCE CERTIFICATE OR REQUIREMENTS**

**The insurance requirements which apply to this contract are  
contained in the pages immediately following this page  
which include the following attachments:**

**These pages are not included in the page numbering of this contract document.**



**CITY AND COUNTY OF DENVER  
INSURANCE REQUIREMENTS FOR THE DEPARTMENT OF AVIATION**

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Certificate Holder Information:

CITY AND COUNTY OF DENVER  
Attn: Risk Management, Suite 8810  
Manager of Aviation  
Denver International Airport  
8500 Peña Boulevard  
Denver CO 80249

**CONTRACT NAME & NUMBER TO WHICH THIS INSURANCE APPLIES: 201734681 Conveyance Replacement & Modernization**

## **I. MANDATORY COVERAGE**

### **Colorado Workers' Compensation and Employer Liability**

**Minimum Limits of Liability (In Thousands)** \$100, \$500, \$100

1. Contractor expressly represents to the City, as a material representation upon which the City is relying in entering into this Agreement, that none of the Contractor's officers or employees who may be eligible under any statute or law to reject Workers' Compensation Insurance shall effect such rejection during any part of the term of this Agreement. Any such rejections previously effected, must have been revoked as of the date Contractor executes this Agreement.
2. If the contractor/consultant is a sole proprietor, Workers' Compensation is waived per State of Colorado law.

### **Commercial General Liability**

**Minimum Limits of Liability (In Thousands):**

Each Occurrence:	\$1,000
General Aggregate Limit:	\$2,000
Products-Completed Operations Aggregate Limit:	\$2,000
Personal & Advertising Injury:	\$1,000

The policy must provide the following:

1. That this Agreement is an Insured Contract under the policy.
2. Defense costs are outside the limits of liability.
3. A severability of interests or separation of insureds provision (no insured vs. insured exclusion).
4. A provision that coverage is primary and non-contributory with other coverage or self-insurance maintained by the City.
5. The full limits of coverage must be dedicated to apply to each project/location.

### **Business Automobile Liability**

**Minimum Limits of Liability (In Thousands):**

Combined Single Limit	\$1,000
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The policy must provide the following:

1. Coverage applicable to all owned, hired and non-owned vehicles used in performing services under this Agreement.
2. If transporting wastes, hazardous material, or regulated substances, Contractor shall carry a pollution coverage endorsement and an MCS 90 endorsement on their policy.

## II. ADDITIONAL COVERAGE

### Excess/Umbrella Liability

#### Minimum Limits of Liability (In Thousands):

Umbrella Liability Controlled Area	Each Occurrence and aggregate	\$9,000
Umbrella Liability Non-Controlled Area	Each Occurrence and aggregate	\$1,000

The policy must provide the following:

1. Coverage must be written on a "follow form" or broader basis.
2. Any combination of primary and excess coverage may be used to achieve required limits.
3. If operations include unescorted airside access at DIA, then a \$9 million Umbrella Limit is required.

### Builders' Risk Insurance or Installation Floater

#### Minimum Limits of Liability (In Thousands)

Special Completed Value Basis

The policy must provide the following:

1. The insurance must be in the amount of the initial Contract Sum, plus value of subsequent modifications, change orders, and cost of material supplied or installed by others, comprising total value of the entire Project at the site on a replacement cost basis.
2. The insurance shall be written on a **Special Completed Value** Covered Cause of Loss form and shall include theft, vandalism, malicious mischief, collapse, false-work, temporary buildings, transit, debris removal, demolition, increased cost of construction, flood (including water damage), earthquake, and if applicable, all below and above ground structures, piping, foundations including underground water and sewer mains, pilings including the ground on which the structure rests and excavation, backfilling, filling and grading.
3. The Policy shall remain in force until formal acceptance of the project by the City or the placement of permanent property insurance coverage whichever is later.
4. The Builders' Risk shall include a Beneficial Occupancy Clause. The policy shall specifically permit occupancy of the building during construction. Contractor shall take reasonable steps to obtain consent of the insurance company and delete any provisions with regard to restrictions within any Occupancy Clauses within the Builder's Risk Policy.
5. Equipment Breakdown Coverage (a.k.a. Boiler & Machinery) shall be included as required by the Contract Documents or by law, which shall specifically covers insured equipment during installation and testing (including cold and hot testing).

## III. ADDITIONAL CONDITIONS

It is understood and agreed, for the benefit of the City, that the following additional conditions shall apply to all coverage specified herein:

1. For Commercial General Liability, Auto Liability and Excess Liability/Umbrella (if required), Contractor and subcontractor's insurer(s) shall include the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured.
2. All coverage provided herein shall be primary and any insurance maintained by the City shall be considered excess.
3. For all coverages required under this Agreement, Contractor's insurer shall waive subrogation rights against the City.
4. The City shall have the right to verify or confirm, at any time, all coverage, information or representations contained herein, and the insured and its undersigned agent shall promptly and fully cooperate in any such audit the City may elect to undertake.
5. The required insurance shall be underwritten by an insurer licensed or authorized to do business in Colorado and rated by A.M. Best Company as "A-"VIII or better.
6. For claims-made coverage, the retroactive date must be on or before the contract date or the first date when any goods or services were provided to the City, whichever is earlier
7. No changes, modifications or interlineations on this document shall be allowed without the review and approval of the Risk Administrator prior to contract execution.

### **NOTICE OF CANCELLATION**

It is understood and agreed that should any Policy issued hereunder be cancelled or non-renewed before the expiration date thereof, or sustain a material change in coverage adverse to the City, the issuing company or its authorized Agent shall give notice to the Department of Aviation in accordance with policy provisions.



## DENVER INTERNATIONAL AIRPORT PARTIAL LIEN RELEASE – CONSTRUCTION (Subcontractor)

Project: _____	Date: _____
City Contract No. _____	Current Subcontract Amount: \$ _____
FROM: Subcontractor _____	(1) Last Progress Payment for billing period ending _____ 20__
Address: _____	\$ _____
City/State: _____	(2) Progress invoiced for previous billing period (if unpaid) _____ 20__
Telephone: _____	\$ _____
TO: Contractor _____	(3) Progress invoiced for current billing period ending _____ 20__
Address: _____	\$ _____
City/State: _____	(4) <b>Total Paid to Date:</b>
	\$ _____

( ) MBE/WBE      ( ) SBE      ( ) DBE      ( ) Non

The Undersigned hereby certifies that all costs, charges or expenses incurred by the undersigned or on behalf of the undersigned for any work, labor or services performed and for any materials, supplies or equipment provided on the above referenced Project or used in connection with the above referenced Subcontract (the "Work Effort") have been duly paid in full to date.

The Undersigned further certifies that each of the undersigned's subcontractors and suppliers that incurred or caused to be incurred, on their behalf, costs, charges or expenses in connection with the undersigned's Work Effort on the above referenced Project have been duly paid in full to date.

The Undersigned hereby (1) acknowledges receipt of the progress payment referred to above as the Last Progress Payment which, when added to the total of all previous progress payments, constitutes full payment, less retainage, for all labor, services, material and supplies which the undersigned has provided for use in and upon the project described above through \_\_\_\_\_, 20\_\_ and, (2) hereby releases the Contractor, surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier from any and all claims prior to the above mentioned date, except for the withheld retainage.

The Undersigned also hereby agrees that the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier shall be released from any and all claims arising out of its performance or non-performance of any contract associated with the above project through \_\_\_\_\_, 20\_\_, except for withheld retainage after it has received full payment, less retainage, of the amount invoiced for the current billing period.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and hold harmless the City, its officers, employees, agents and assigns and the above-referenced Contractor from and

against all costs, losses, damages, causes of action, judgments under the subcontract and expenses arising out of or in connection with any claim or claims against the City or the Contractor which arise out of the Undersigned's performance of the Work Effort and which may be asserted by the Undersigned or any of its suppliers or subcontractors of any tier or any of their representatives, officers, agents, or employees.

It is acknowledged that this release is for the benefit of and may be relied upon by the City and the referenced Contractor.

The foregoing shall not relieve the undersigned of any obligation under the provisions of the Undersigned's subcontract, as the subcontract may have been amended, which by their nature survive completion of the Undersigned's work effort including, without limitation, warranties, guarantees, insurance requirements and indemnities.

Subcontractor: \_\_\_\_\_

Certified by: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_



# DENVER INTERNATIONAL AIRPORT FINAL LIEN RELEASE – CONSTRUCTION (Subcontractor)

Project: \_\_\_\_\_ Date: \_\_\_\_\_

City Contract No. \_\_\_\_\_ Subcontractor Contract No. \_\_\_\_\_

FROM: Dated: \_\_\_\_\_, 20\_\_

Subcontractor: \_\_\_\_\_ (1) Last Progress Payment for billing  
period ending \_\_\_\_\_, 20\_\_

Address: \_\_\_\_\_ \$ \_\_\_\_\_

City/State: \_\_\_\_\_ (2) Does not apply

Telephone: \_\_\_\_\_

TO: Contractor: \_\_\_\_\_ (3) Does not apply

Address: \_\_\_\_\_

City/State: \_\_\_\_\_ (4) **Total Paid to Date:**  
\$ \_\_\_\_\_

SBE       DBE       MBE       WBE       Non

The Undersigned hereby certifies that all costs, charges or expenses incurred by the undersigned or on behalf of the undersigned for any work, labor or services performed and for any materials, supplies or equipment provided on the above referenced Project or used in connection with the above referenced Subcontract (the "Work Effort") have been duly paid in full.

The Undersigned further certifies that each of the undersigned's subcontractors and suppliers that incurred or caused to be incurred, on their behalf, costs, charges or expenses in connection with the undersigned's Work Effort on the above referenced Project have been duly paid in full.

The undersigned Subcontractor hereby (1) acknowledges receipt of the progress payment referred to above as the Last Progress Payment which, when added to the total of all previous progress payments, constitutes full payment for all labor, services, materials and supplies which the undersigned has provided for use in and upon the project described above through \_\_\_\_\_, 20\_\_ and, (2) hereby releases the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier from any and all claims prior to the above mentioned date.

The Subcontractor also hereby agrees that the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier shall be released from any and all claims arising out of its performance or non-performance of any contract associated with the above project.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and hold harmless the City, its officers, employees, agents and assigns and the above-referenced Contractor from and against all costs, losses, damages, causes of action, judgments under the subcontract and expenses arising out of or in connection with any claim or claims against the City or the Contractor which arise out of the Undersigned's performance of the Work Effort and which may be asserted by the Undersigned or any of its suppliers or subcontractors of any tier or any of their representatives, officers, agents, or employees.

It is acknowledged that this release is for the benefit of and may be relied upon by the City and the referenced Contractor.

The foregoing shall not relieve the undersigned of any obligation under the provisions of the Undersigned's subcontract, as the subcontract may have been amended, which by their nature survive completion of the Undersigned's work effort including, without limitation, warranties, guarantees, insurance requirements and indemnities.

Subcontractor: \_\_\_\_\_

Certified by: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

**EXHIBIT I**

**CITY AND COUNTY OF DENVER  
RULES AND REGULATIONS AND TASK ORDER  
CONDITIONS OF THE  
MANAGER OF PUBLIC WORKS**

**PERTAINING TO EQUAL EMPLOYMENT OPPORTUNITY  
IN THE CITY AND COUNTY OF DENVER**

APPROVED FOR LEGALITY:

APPROVED AND ADOPTED:

/s/ \_\_\_\_\_  
Attorney for the City and  
County of Denver

/s/ \_\_\_\_\_  
Manager of Public Works

Adopted and Published Pursuant to Article 111, Division 2 of Chapter 28  
the Revised Municipal Code  
of the City and County of Denver

These Rules and Regulations cancel and supersede any and all previous issued Rules and  
Regulations on the subject

**RULES AND REGULATIONS**  
**REGARDING**  
**EQUAL EMPLOYMENT OPPORTUNITY**

Promulgated and adopted by the Manager of Public Works pursuant to and by authority of Article III, Division 2, Chapter 28 of the Revised Municipal Code of the City and County of Denver, and for the purpose of insuring that contractors, subcontractors and suppliers soliciting and receiving compensation for contract work from or through the City and County of Denver provide equal opportunity in employment without regard to race, color, creed, sex, national origin, age, religion, marital status, political opinion or affiliation or mental or physical handicap and meet certain requirements for the hiring, training, promotion and treatment during employment of members of ethnic groups subjected to differential treatment, including persons of African descent (Black), Spanish-surnamed (Hispanic), Asian-American and American Indian groups.

**RULE I**  
**DEFINITIONS**

- A. "City" means the City and County of Denver.
- B. "Manager" shall mean the Manager of Public Works for the City and County of Denver.
- C. "Contract" means a contract entered into with the City and County of Denver, financed in whole or in part by local resources or funds of the City and County of Denver, for the construction of any public building or prosecution or completion of any public work.
- D. "Contractor" means the original party to a contract with the City and County of Denver, also referred to as the "general" or "prime" contractor.
- E. "Director" means the Director of the Mayor's Office of Contract Compliance.
- F. "Subcontractor" means any person, company, association, partnership, corporation, or other entity which assumes by subordinate agreement some or all of the obligations of the general or prime contractor.
- G. The Phrase "Bidding Specifications" as used in Article 111, Division 2 of Chapter 28 of the Revised Municipal Code shall include BID CONDITION, INVITATION TO BID AND NOTICE OF PROPOSAL.
- H. "Affirmative Action Program" means a set of specific and result-oriented procedures or steps to which a contractor commits himself to apply every good faith effort to employ members of ethnic minority groups, to include persons of African descent (Black), Spanish surnamed (Hispanic), Asian-American, American Indians, and persons with mental or physical handicap.
- I. "Mayor's Office of Contract Compliance" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

**RULE 11**  
**NOTICE OF HEARING**

When results of conciliation efforts are unsatisfactory to the Manager and he is informed in accordance with Article III, Division 2 of Chapter 28 of the Revised Municipal Code that a contractor or subcontractor has apparently failed to meet affirmative action and equal



employment opportunity requirements after a reasonable period of notice to correct deficiencies, the Manager will, prior to imposition of any sanctions, afford the general contractor a hearing in order to determine whether the contractor or his subcontractors have failed to comply with the affirmative action and equal employment opportunity requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or of the contract. Written notice of such hearing shall be delivered personally or sent by certified mail return receipt requested, to the contractor and to any subcontractor involved at least ten days prior to the date scheduled for the hearing.

### **RULE III** **HEARING**

- A. Contractors will appear at hearings and may be represented by counsel, and may present testimony orally and other evidence.
- B. Hearings shall be conducted by one or more hearing examiners designated as such by the Manager.
- C. The Director of the Mayor's Office of Contract Compliance may participate in hearings as a witness.
- D. Hearings shall be held at the place specified in the notice of hearing.
- E. All oral testimony shall be given under oath or affirmation and a record of such proceedings shall be made.
- F. All hearings shall be open to the public.
- G. The hearing officer shall make recommendations to the Manager who shall make a final decision.

### **REGULATIONS**

**REGULATION NO. 1.**      **ORDINANCE:** The Rules and Regulations of the Manager shall be inserted in the bidding specifications for every contract for which bidding is required.

**REGULATION NO. 2.**      **EXEMPTIONS:** Each contract and subcontract, regardless of dollar amount, shall be subject to affirmative action requirements unless specifically exempted in writing individually by the Manager. Exemptions apply only to "affirmative action" in equal employment opportunity, and are not to be construed as condonation in any manner of "discrimination" or "discriminatory practices" in employment because of race, color, creed sex age national origin, religion, marital status, political opinion or mental or physical handicap.

**REGULATION NO. 3.**      **DIRECTOR OF CONTRACT COMPLIANCE:** The Director of the Mayor's Office of Contract Compliance shall perform the duties assigned to such official by Article III, Division 2 of Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Mayor's Office of Contract Compliance or designated representatives shall inform bidders and contractors of affirmative action procedures, programs, and goals in accordance with the ordinance at pre-bid and pre-construction conference; (2) make regular on-site inspections; (3) supply contractors and subcontractors with report forms to be completed by them when requested, and furnished to the Director of the Mayor's Office of Contract Compliance; and (4) review payroll records, employment records and practices of general contractors and their subcontractors and suppliers during the performance of any contract. The Director of the Mayor's Office of Contract Compliance shall promptly report apparent affirmative action deficiencies to the Manager.

**REGULATION NO. 4. GOALS AND TIMETABLES:** In general, goals and timetables should take into account anticipated vacancies and the availability of skills in the market place from which employees should be drawn. In addition, where discrimination in employment by a general contractor or any of his subcontractors is indicated, a corrective action program will take into account the need by the general contractor and his subcontractors to correct past discriminatory practices and reach goals of minority manpower utilization on a timely basis through such recruiting and advertising efforts as are necessary and appropriate.

**REGULATION NO.5. AWARD OF CONTRACTS:** It shall be the responsibility of the Director of the Mayor's Office of Contract Compliance to determine the affirmative action capability of bidders, contractors and subcontractors and to recommend to the Manager the award of contracts to those bidders, contractors and subcontractors and suppliers who demonstrate the ability and willingness to comply with the terms of their contract.

**REGULATION NO. 6. PUBLICATION AND DUPLICATION:** Copies of these Rules and Regulations as amended by the Manager from time to time, shall as soon as practicable and after Notice being published will be made a part of all City Contracts.

**REGULATION NO. 7. NOTICE TO PROCEED:** Prior to issuance of Notice to Proceed a sign-off will be required of the Director of the Mayor's Office of Contract Compliance or his designee.

**REGULATION NO. 8. CONTRACTS WITH SUBCONTRACTORS:** To the greatest extent possible the contractor shall make a good faith effort to contract with minority contractors, subcontractors and suppliers for services and supplies by taking affirmative actions which include but are not limited to the following:

1. Advertise invitations for subcontractor bids in minority community news media.
2. Contact minority contractor organizations for referral of prospective subcontractors.
3. Purchase materials and supplies from minority material suppliers.

**REGULATION NO. 9. AGENCY REFERRALS:** it shall be no excuse that the union with which the contractor or subcontractor has an agreement providing for referral, exclusive or otherwise, failed to refer minority employees.

**REGULATION NO. 10. CLAUSES:** The Manager shall include the appropriate clauses in every contract and the contractor shall cause to be inserted in every subcontract the appropriate clauses:

1. **APPENDIX A:** City and County of Denver Equal Opportunity Clause-ALL CONTRACTS funded only with City & County of Denver monies.
2. **APPENDIX B:** Equal Opportunity Clause (11246)-ALL FEDERAL ASSISTED
3. **APPENDIX C:** Section 3-Assurance of Compliance-HUD ASSISTED PROJECTS.
4. **APPENDIX D:** Section 3-Clause-HUD ASSISTED PROJECTS.

All amendments to the appendices shall be included by reference.

**REGULATION NO. 11. SHOW CAUSE NOTICES:** When the Manager has reasonable cause to believe that a contractor has violated Article III, Division 2 of Chapter 28 of the Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen days why enforcement procedures, or other appropriate action to insure compliance, should not be instituted.

**REGULATION NO. 12. BID CONDITIONS-AFFIRMATIVE ACTION REQUIREMENTS-**

**EQUAL EMPLOYMENT OPPORTUNITY:**

**1. APPENDIX E:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as amended and published by the U.S. Department of Labor, Employment Standards Administration, Office of Federal Contract Compliance, shall be inserted verbatim for bidding specification for every non-exempt contract involving the use of Federal funds.

**2. APPENDIX F:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as published by the Department of Public Works, City and County of Denver shall be inserted verbatim as bidding specifications for every non-exempt contract using City funds.

**APPENDIX A**

**CITY AND COUNTY OF DENVER EQUAL OPPORTUNITY CLAUSE-ALL CONTRACTS**

1. The contractor will not discriminate against any employee or applicant for employment because of race creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided, advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. Each contractor will comply with all provisions of Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and Director.
5. The contractor will furnish all information and reports required by Article III, Division 2, Chapter 28 of the Revised Municipal Code, and by rules, regulations and orders of the Manager and Director or pursuant thereto, and will permit access to his books, records, and accounts by the Manager, Director or their designee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders this contract may be cancelled, terminated., or suspended in whole or in part and the contractor may be declared ineligible for further City contracts in accordance with procedures authorized in

Article III, Division 2, Chapter 28 of the Revised Municipal Code, or by rules, regulations, or order of the Manager.

7. The contractor will include Regulation 12 Paragraph 2 and the provisions of paragraphs (1) through (6) in every subcontract or purchase order unless, exempted by rules, regulations, or orders of the Manager issued pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, so that such provisions will be binding upon each subcontractor or suppliers. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.  
The applicant further agrees to be bound by the above equal opportunity clauses with respect to its own employment practices when it participates in City contracts. The contractor agrees to assist and cooperate actively with the Manager and the Director in obtaining compliance of subcontractors and suppliers with the equal opportunity clause and the rules, regulations and relevant orders of the Manager, and will furnish the Manager and the Director such information as they may require for the supervision of compliance, and will otherwise assist the Manager and Director in the discharge of the City's primary responsibility for securing compliance. The contractor further agrees to refrain from entering into any contract or contract modification subject to Article III, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who has not demonstrated eligibility for, City contracts.  
The contractor will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the Manager and Director. In addition, the contractor agrees that failure or refusal to comply with these undertakings the Manager may take any or all of the following actions:
  - A. Cancellation, termination, or suspension in whole or in part of this contract.
  - B. Refrain from extending any further assistance to the applicant under the program with respect to which the failure occurred until satisfactory assurance of future compliance has been received from such applicant.
  - C. Refer the case to the City Attorney for appropriate legal proceedings.

**SUBCONTRACTS:** Each prime contractor or subcontractor shall include the equal opportunity clause in each of its subcontracts.

**APPENDIX F  
BID CONDITIONS  
AFFIRMATIVE ACTION REQUIREMENTS  
EQUAL EMPLOYMENT OPPORTUNITY**

For all Non-Exempt Construction Contracts to be Awarded by  
the City and County of Denver, Department of Public Works

**NOTICE**

EACH BIDDER, CONTRACTOR OR SUBCONTRACTOR (HEREINAFTER THE CONTRACTOR) MUST FULLY COMPLY WITH THE REQUIREMENTS OF THESE BID CONDITIONS AS TO EACH CONSTRUCTION TRADE IT INTENDS TO USE ON THIS CONSTRUCTION CONTRACT, AND ALL OTHER CONSTRUCTION WORK (BOTH CITY AND NON-CITY) IN THE DENVER AREA DURING THE PERFORMANCE OF THIS CONTRACT OR SUBCONTRACT. THE CONTRACTOR COMMITS ITSELF TO THE GOALS FOR MINORITY MANPOWER UTILIZATION, AS APPLICABLE, AND ALL OTHER REQUIREMENTS, TERMS AND CONDITION OF THESE BID CONDITIONS BY SUBMITTING A PROPERLY SIGNED BID.

THE CONTRACTOR SHALL APPOINT A COMPANY EXECUTIVE TO ASSUME THE RESPONSIBILITY FOR THE IMPLEMENTATION OF THE REQUIREMENTS, TERMS AND CONDITIONS OF THESE BID CONDITIONS.

MICHAEL D. MUSGRAVE  
Manager of Public Works  
City and County of Denver

**A. REQUIREMENTS --AN AFFIRM ATIVE ACTION PLAN:**

Contractors shall be subject to the provisions and requirements of these bid conditions including the goals and timetables for minority' and female utilization, and specific affirmative action steps set forth by the Office of Contract Compliance. The contractor's commitment to the goals for minority, and female utilization as required constitutes a commitment that it will make every good faith effort to meet such goals.

**1. GOALS AND TIMETABLES:**

The goals and timetables for minority<sup>1</sup> and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade are as follows:

**GOALS FOR MINORITY PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 21.7% - 23.5%  
Until Further Notice

**GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 6.9%  
Until Further Notice

The goals for minority and female utilization above are expressed in terms of hours of training and employment as a proportion of the total number of hours to be worked by the contractor's aggregate workforce, which includes all supervisory personnel, in each trade, on all projects for the City and County of Denver during the performance of its contract (i.e., The period beginning with the first day of work on the City and County of Denver funded construction contract and ending with the last day of work).

The hours of minority and female employment and training must be substantially uniform throughout the length of the contract in each trade and minorities and females must be employed evenly on each of a contractor's projects. Therefore, the transfer of minority or female employees from contractor to contractor or from project to project for the purpose of meeting the contractor's goals shall be a violation of these Bid Conditions.

If the contractor counts the nonworking hours of apprentices they must be employed by the contractor during the training period; the contractor must have made a commitment to employ apprentices at the completion of their training subject to the availability of employment opportunities; and the apprentices must be trained pursuant to training programs approved by the Bureau of Apprenticeship and Training.

**2. SPECIFIC AFFIRM ATIVE ACTION STEPS:**

No contractor shall be found to be in noncompliance solely on account of its failure to meet its goals, but will be given an opportunity to demonstrate that the contractor has instituted all the specific affirmative action steps specified and has made every good faith effort to make these steps work toward the attainment of its goals within the timetables, all to the purpose of expanding minority and female utilization in its

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<sup>1</sup> "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian-Americans, and American Indians, and includes both men and Minority women.

aggregate workforce. A contractor, who fails to comply with its obligation under the Equal Opportunity Clause of its contract and fails to achieve its commitments to the goals for minority and female utilization has the burden of proving that it has engaged in an Affirmative Action Program directed at increasing minority and female utilization and that such efforts were at least as extensive and as specific as the following:

- a. The contractor should have notified minority and female organizations when employment opportunities were available and should have maintained records of the organization's response.
- b. The contractor should have maintained a file of the names and addresses of each minority and female referred to it by any individual or organization and what action was taken with respect to each such referred individual, and if the individual was not employed by the contractor, the reasons. If such individual was sent to the union hiring hall for referral and not referred back by the union or if referred, not employed by the contractor, the file should have documented this and their reasons.
- c. The contractor should have promptly notified the Department of Public Works, and Mayor's Office of Contract Compliance when the union or unions with which the contractor has collective bargaining agreements did not refer to the contractor a minority or female sent by the contractor, or when the contractor has other information that the union referral process has impeded efforts to meet its goals.
- d. The contractor should have disseminated its EEO policy within its organization by including it in any employee handbook or policy manual; by publicizing it in company newspapers and annual reports and by advertising such policy at reasonable intervals in union publications. The EEO policy should be further disseminated by conducting staff meetings to explain and discuss the policy; by posting of the policy; and by review of the policy with minority and female employees.
- e. The contractor should have disseminated its EEO policy externally by informing and discussing it with all recruitment sources; by advertising in news media, specifically including minority and female news media; and by notifying and discussing it with all subcontractors.
- f. The contractor should have made both specific and reasonably recurrent written and oral recruitment efforts. Such efforts should have been directed at minority and female organizations, schools with substantial minority and female enrollment, and minority and female recruitment and training organizations within the contractor's recruitment area.
- g. The contractor should have evidence available for inspection that all tests and other selection techniques used to select from among candidates for hire, transfer, promotion, training, or retention are being used in a manner that does not violate the OFCCP Testing Guidelines in 41 CFR Part 60-3.
- h. The contractor should have made sure that seniority practices and job classifications do not have a discriminatory effect.
- i. The contractor should have made certain that all facilities are not segregated by race.

- j. The contractor should have continually monitored all personnel activities to ensure that its EEO policy was being carried out including the evaluation of minority and female employees for promotional opportunities on a quarterly basis and the encouragement of such employees to seek those opportunities.
- k. The contractor should have solicited bids for subcontracts from available minority and female subcontractors engaged in the trades covered by these Bid conditions, including circulation of minority and female contractor associations.

**NOTE:** The Director and the Mayor's Office of Contract Compliance will provide technical assistance on questions pertaining to minority and female recruitment sources, minority and female community organizations, and minority and female news media upon receipt of a request for assistance from a contractor.

3. **NON-DISCRIMINATION:**

In no event may a contractor utilize the goals and affirmative action steps required in such a manner as to cause or result in discrimination against any person on account of race, color, religion, sex, marital status, national origin, age, mental or physical handicap, political opinion or affiliation.

4. **COMPLIANCE AND ENFORCEMENT:**

In all cases, the compliance of a contractor will be determined in accordance with its obligations under the terms of these Bid Conditions. All contractors performing or to perform work on projects subject to these Bid Conditions hereby agree to inform their subcontractors in writing of their respective obligations under the terms and requirements of these Bid Conditions, including the provisions relating to goals of minority and female employment and training.

A. **Contractors Subject to these Bid Conditions:**

In regard to these Bid Conditions, if the contractor meets the goals set forth therein or can demonstrate that it has made every good faith effort to meet these goals, the contractor shall be presumed to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, the implementing regulations and its obligations under these Bid Conditions. In the event, no formal sanctions or proceedings leading toward sanctions shall be instituted unless the contracting or administering agency otherwise determines that the contractor is violating the Equal Opportunity Clause.

- 1. Where the Office of Contract Compliance finds that a contractor failed to comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code or the implementing regulations and the obligations under these Bid Conditions, and so informs the Manager, the Manager shall take such action and impose such sanctions, which include suspension, termination, cancellation, and debarment, as may be appropriate under the Ordinance and its regulations. When the Manager proceeds with such formal action it has the burden of proving that the contractor has not met the goals contained in these Bid Conditions. The contractor's failure to meet its goals shall shift to it the requirement to come forward with evidence to show that it has met the good faith requirements of these Bid Conditions.



2. The pendency of such proceedings shall be taken into consideration by the Department of Public Works in determining whether such contractor can comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Mayor's Office of Contract Compliance shall review the contractor's employment practices during the performance of the contract. If the Mayor's Office of Contract Compliance determines that the contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

**B. Obligations Applicable to Contractors:**

It shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority or female employees. Discrimination in referral for employment, even if pursuant to provisions of a collective bargaining agreement, is prohibited by the National Labor Relations Act, as amended, Title VI of the Civil Rights Act of 1964, as amended, and Article III, Division 2, Chapter 28 of the Revised Municipal Code. It is the policy of the Department of Public Works that contractors have a responsibility to provide equal employment opportunity, if they wish to participate in City and County of Denver contracts. To the extent they have delegated the responsibility for some of their employment practices to a labor organization and, as a result, are prevented from meeting their obligations pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, such Contractors cannot be considered to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, or its implementing rules and regulations.

**C. General Requirements**

Contractors are responsible for informing their subcontractors in writing regardless of tier, as to their respective obligations. Whenever a contractor subcontracts a portion of work in any trade covered by these Bid Conditions, it shall include these Bid Conditions in such subcontracts and each subcontractor shall be bound by these Bid Conditions to the full extent as if it were the prime contractor. The contractor shall not, however, be held accountable for the failure of its subcontractors to fulfill their obligations under these Bid Conditions. However, the prime contractor shall give notice to the Director of any refusal or failure of any subcontractor to fulfill the obligations under these Bid Conditions. A subcontractor's failure to comply will be treated in the same manner as such failure by a prime contractor.

1. Contractors hereby agree to refrain from entering into any contract or contract modification subject to Article 111, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who is determined not to be a "responsive" bidder for the City and County of Denver contracts pursuant to the Ordinance.
2. The contractor shall carry out such sanctions and penalties for violation of these Bid Conditions and the Equal Opportunity Clause including suspension, termination and cancellation of existing subcontracts and

debarment from future contracts as may be ordered by the Manager pursuant to Article 111, Division 2, Chapter 28 of the Revised Municipal Code and its implementing regulations.

3. Nothing herein is intended to relieve any contractor during the term of its contract from compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the Equal Opportunity Clause of its contract with respect to matters not covered in these Bid Conditions.
4. Contractors must keep such records and file such reports relating to the provisions of these Bid Conditions as shall be required by the Office of Contract Compliance.
5. Requests for exemptions from these Bid Conditions must be made in writing, with justification, to the Manager of Public Works, City and County Building, Room 379, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

## **Appendix No. 1**

### **Standard Federal Assurances and Nondiscrimination**

# APPENDIX 1(A)

## COMPLIANCE WITH NONDISCRIMINATION REQUIREMENTS

NOTE: As used below the term "Contractor" shall mean and include Concessionaire, and the term "sponsor" shall mean the "City." During the term of this Contract, the Contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

- 1. Compliance with Regulations.** The Contractor will comply with the Title VI List of Pertinent Non-Discrimination Statutes and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made part of this Agreement.
- 2. Nondiscrimination.** The Contractor, with regard to the work performed by it during this Agreement, will not discriminate on the grounds of race, creed, color, national origin, or sex in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and Regulations, including employment practices when the Agreement covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
- 3. Solicitations for Subcontractors, Including Procurements of Materials and Equipment.** In all solicitations, either by competitive Task Ordering or negotiation, made by the Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the Contractor's obligations under this Agreement and the Acts and Regulations relative to nondiscrimination on the grounds of race, color, or national origin.
- 4. Information and Reports.** The Contractor will provide all information and reports required by the Acts, Regulations or directives issued pursuant thereto and will permit access to its books, records, accounts other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration (FAA) to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the sponsor or the FAA, as appropriate, and will set forth what efforts it has made to obtain the information.
- 5. Sanctions for Noncompliance.** In the event of a Contractor's noncompliance with the nondiscrimination provisions of this Agreement, the sponsor will impose such Contract sanctions as it or the FAA may determine to be appropriate, including, but not limited to:

  - a. Withholding of payments to the Contractor under this Agreement until the Contractor complies, and/or;
  - b. Cancelling, terminating, or suspending this Agreement, in whole or in part.
- 6. Incorporation of Provisions.** The Contractor will include the provisions of paragraphs one (1) through six (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations or directives issued pursuant thereto. The

Contractor will take action with respect to any subcontract or procurement as the sponsor or the FAA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the sponsor to enter into such litigation to protect the interests of the sponsor. In addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

## APPENDIX 1(C)

### STANDARD FEDERAL ASSURANCES AND NONDISCRIMINATION IN CONSTRUCTION, MAINTENANCE, OPERATION OF FACILITIES

As used below, the term “sponsor” will mean City.

Concessionaire, for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as part of consideration hereof, does hereby covenant and agree, as a covenant running with the land that:

1. In the event facilities are constructed, maintained, or otherwise operated on the property described in this Agreement for a purpose for which a FAA activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the Concessionaire will maintain and operate such facilities and services in compliance with all requirements imposed by the Nondiscrimination Acts and Regulations listed in the Pertinent List of Nondiscrimination Authorities, as may be amended from time to time, such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
2. With respect to this Agreement, in the event of breach of any of the above Nondiscrimination covenants, sponsor will have the right to terminate this Agreement, and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if this Agreement had never been made or issued.

## APPENDIX 1(D)

### STANDARD FEDERAL ASSURANCES AND NONDISCRIMINATION IN CONSTRUCTION, USE, OR ACCESS TO FACILITIES

As used below, the term “sponsor” will mean City.

- A. Concessionaire for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as part of the consideration hereof, does hereby covenant and agree, as a covenant running with the land, that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the Concessionaire will use the Premises in compliance with all other requirements imposed by or pursuant to the List of Pertinent Nondiscrimination Authorities.
- B. With respect this Agreement, in the event of breach of any of the above nondiscrimination covenants, sponsor will have the right to terminate this Agreement and to enter, re-enter, and repossess said land and the facilities thereon, and hold the same as if this Agreement had never been made or issued.

## APPENDIX 1(E)

### TITLE VI LIST OF PERTINENT NONDISCRIMINATION AUTHORITIES

As used below, the term "Contractor" will mean and include Concessionaire and the term "sponsor" will mean City.

During the performance of this Agreement, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor") agrees to comply with the following nondiscrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252), (prohibits' discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination In Federally-Assisted Programs of The Department of Transportation-Effectuation of Title VI of The Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601 ), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S. C. § 794 *et seq.*), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.*), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC§ 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 1 00-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and Contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 -12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;



- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S. C. 1681 et seq).

## APPENDIX 2

### DISADVANTAGED BUSINESS ENTERPRISES- REQUIRED STATEMENTS

As used below, the term "Contractor" will mean and include Concessionaire and the term "sponsor" will mean City.

**Contract Assurance (§ 26.13)** – The Contractor or subcontractor will not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor will carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT assisted Contracts. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy, as the recipient deems appropriate.

**Prompt Payment (§26.29)** – The prime Contractor agrees to pay each subcontractor under this prime Contract for satisfactory performance of its Contract no later than thirty (30) days from the receipt of each payment the prime Contractor receives from Contractor. The prime Contractor agrees further to return retainage payments to each subcontractor within thirty (30) days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the sponsor. This clause applies to both DBE and non-DBE subcontractors.

**EXHIBIT A**

**CITY AND COUNTY OF DENVER  
DIVISION OF SMALL BUSINESS OPPORTUNITY**

**CONSTRUCTION CONTRACT COMPLIANCE PLAN  
FOR M/WBE PARTICIPATION**

**[NAME OF CONTRACTOR]**

**[NAME OF PROJECT]**

**[CONTRACT NO.]**

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**CITY AND COUNTY OF DENVER  
DIVISION OF SMALL BUSINESS OPPORTUNITY  
CONSTRUCTION CONTRACT COMPLIANCE PLAN  
FOR M/WBE PARTICIPATION**

**[NAME OF CONTRACTOR]  
[NAME OF PROJECT]  
[CONTRACT NO.]**

**SECTION 1: INTRODUCTION**

- A. [NAME OF COMPANY] (the “Contractor”) submits this Compliance Plan to the Director of the Division of Small Business Opportunity (“Director”), as required by the Manager of Aviation, in accordance with §§ 28-51 to 28-83, D.R.M.C., and the implementing rules adopted by the Director (“Rules”).
- B. Under the City’s Ordinance No. 85, Series of 2014 (the “M/WBE Ordinance”), codified at §§ 28-51 to 28-83, D.R.M.C., the M/WBE participation goal for this contract is \_\_\_%. The good faith solicitation level is 100%
- C. The Contractor is committed to compliance with the M/WBE Ordinance in its performance of the Contract. The Contractor will continually pursue a level of M/WBE participation that equals or exceeds [goal]% of the total construction price under the Contract for each task order.
- D. Because of the delivery method used for this Project, the work was not ready for subcontracting at the time when the Contractor was awarded the Contract. Therefore this Compliance Plan provides for the M/WBE solicitation and subcontracting to be performed after contract formation. The process by which the Contractor will solicit, obtain, count and maintain participation by MBE and WBE firms for this Project under this Compliance Plan, will be same as the M/WBE Ordinance requires for “design-bid-build” construction contracts, but will apply to individual task orders.
- E. This Compliance Plan describes how the Contractor will address the project goal on a per task order basis at the point where task orders are assigned so that the process of obtaining subcontractors and suppliers can begin, by committing to utilize MBE/WBEs for the Project work, using the good faith efforts as defined by the M/WBE Ordinance.
- F. The delivery method for this project under the Contract is On Call Construction Services.
- G. Since the work will be delivered by task order, Section 3 below describes the Contractor’s plan to meet the project goal as it relates to each task order.

## SECTION 2: KEY PERSONNEL

[NAME], [telephone number], [email address], has been assigned as the [title – probably Project Manager] for this Contract. The [title] is responsible for the overall management of the Contractor’s performance of the Project.

*[Identify the other key staff who will be responsible for carrying out the Compliance Plan, and for contract administration for subcontractors and suppliers, etc. The following are examples, to be tailored to the Contractor’s situation:]*

[NAME], [telephone number], [email address], is the [title], who reports to the [Project Manager] and is responsible for compliance with this Compliance Plan, outreach and coordination activities, and maintaining appropriate records to ensure that goals are met.

[NAME], [telephone number], [email address], is the [title], who will administer subcontracts and ensure that all documentation required by DSBO is prepared and maintained. [NAME] will coordinate the collection of DSBO documentation and monthly payroll reports from all subcontractors and suppliers, including but not limited to M/WBEs.

## SECTION 3: STRUCTURING BID PACKAGES FOR M/WBE PARTICIPATION

- A. The Contractor will meet the set goal of [\_\_\_\_]% per task order and Letters of Intent will be due with each task order.

*[Display the information in chart form. Examples are provided below for your use. Customize the form so that it provides the information specific to your project. The total at bottom needs to be the contract total. Showing subtotals along the way for completely different types of work is acceptable. Force accounts and contingency fees may be deducted from the total goals are met upon. The overall committed contract goal is the percentage stated on page 1. ]*

**GOALS SCHEDULE CHART**

Workscope	Tier	Total Contract Scope Value		Estimated Potential MWBE Participation	
		Total Contract \$	Total Contract %	\$ of Listed Scope	% of Constr Services
Aggregates/Embankment	1	\$600,000	10%	100,000	16%
Rebar – Furnish & Install	1				
Fencing	1				
Waterproof Membrane	1				
Concrete Flatwork	1				
Health & Safety Management	1				
Perm Signage – Roadway	1				
Perm Signage – Structures	1				
Metal Guardrail	1				
Asphalt Pavement	2				
Concrete Pavement	2				
<b>Total – Potential MWBE Construction Services</b>					

**GOALS SCHEDULE CHART**

AVAILABLE SUB-TRADE	APPROXIMATE DOLLAR AMOUNT	PERCENT-AGE OF TOTAL PROJECT	ASSIGNED MWBE GOAL PER SECTION	ANTICIPATED RESULTING MWBE PARTICIPATION
Earthwork/Site Demo				
Utilities				
Paving				
Landscape & Irrigation				
Concrete				
Masonry				
Metals				
Carpentry				
Thermal & Moisture				
Doors & Windows				
Finishes				
Specialties				
Mechanical				
Electrical				
<b>SUBTOTAL</b>				
Design				
Self-Performance				
<b>TOTAL</b>				

- B. These packages will be reviewed and refined as the work for the Contract is further defined and ready for the process of subcontracting. Specifically, prior to advertising any package of work for bids or proposals, the Contractor will review the work in detail, to determine the types of work that can be performed by M/WBE firms, with reference to the DSBO's database and directory of certified M/WBE firms, and will adjust its subcontracting packages to maximize opportunities for M/WBE participation in such subcontracting, within economically feasible packages.
- C. The Contractor has the following preliminary schedule for issuance of each task order:
  - [List]
- D. *[Identify any specific issues or potential issues with the contract's scope of work and how the Contractor will address them – specialized work items, etc.]*
- E. *[State whether the Contractor will prequalify any subcontractors. If prequalification will be used, identify all subcontracts for which the Contractor will prequalify subcontractors, and explain the prequalification process that will be used. ]*
- F. The contractor will meet the [\_\_\_\_]% goal on each task order or submit a Good Faith Effort with each task order assigned.
- G. The Contractor may consider, in order to maximize M/WBE participation, subcontracting the following types of work which it might ordinarily self-perform: \_\_\_\_\_.

**SECTION 4: COMMUNITY OUTREACH EFFORTS AND ADVERTISING TO M/WBE CERTIFIED FIRMS:**

The Contractor will conduct the following outreach efforts:

- A. Contractor will use the City's M/WBE directory and encourage all non-M/WBE subcontractors to use the directory when soliciting any of their own subcontractors or suppliers for the project.
- B. If during outreach efforts, Contractor locates a firm which appears to be eligible for City M/WBE certification but is not so certified, Contractor will direct the firm to DSBO and encourage the firm to pursue certification if eligible.
- C. When it has work packages ready for subcontracting, the Contractor will use the City's online directory to specifically solicit City-certified M/WBE participation whenever possible.
- D. *[Identify any additional efforts or initiatives the Contractor will carry out.]*

- E. [Describe the bid/proposal process that will be used.]
- F. The Contractor will send to each bidder/proposer, a Notice of Selection for each subcontract for which it solicited M/WBE participation, no later than 30 days after it has entered into the subcontract, so that unsuccessful bidders/proposers are aware of the result of the bid/proposal process.

## **SECTION 5: M/WBE PARTICIPATION; MAINTAINING COMMITMENTS**

- A. When issuing each task order for bid under the Contract, the Contractor will make a good faith effort to meet or exceed the goal percentage of M/WBE participation which it has identified for that task order. The minimum level of these efforts is specified in § 28-62(b), D.R.M.C. and Rule VII(B). They may include, but will not be limited to, the outreach activities identified in Section 4 above.
- B. When requested by DSBO, the Contractor will submit bid packages to DSBO for review and comment. When requested by DSBO, the Contractor will submit bid tabulation sheets to DSBO for review.
- C. The Contractor will report to DSBO the total M/WBE participation obtained for each task order. No later than 5 days after issuing Notice to Proceed for such work, the Contractor will submit to DSBO, for each M/WBE subcontractor or supplier with whom it contracts, a Letter of Intent and other documentation, in accordance with Section 6 below. If self-performing, then the M/WBE contractor must also submit a letter of intent for itself.
- D. The Contractor will document its efforts to obtain M/WBE participation for each task order, and submit such documentation to DSBO upon request by DSBO at any time. The Contractor acknowledges that it may meet or exceed a percentage goal for M/WBE participation on each task order, or it may fall short of meeting the participation goal for a specific task order. Therefore the Contractor must be able to demonstrate its good faith effort, consistent with § 28-62(b), D.R.M.C., to obtain M/WBE participation for each task order under the contract, except for task orders that are subject to a “modified good faith effort” under § 28-75(c), D.R.M.C., in which case the Contractor must be able to demonstrate its compliance with the requirements of § 28-75(c), D.R.M.C. Sections 28-62(b) and 28-75(c), D.R.M.C., are attached to this Compliance Plan as Attachment 1, for convenient reference.
- E. The M/WBE participation percentage will be calculated by dividing the total value of the M/WBE participation by the total contract amount for the task order, including all change orders. The Contractor will count M/WBE participation according to the M/WBE Ordinance, including § 28-63, D.R.M.C., and Rule VII(C).
- F. As required by D.R.M.C. § 28-73, the Contractor shall immediately inform the DSBO in writing of any agreed-upon increase or decrease in the scope of work of the Contract, regardless of whether it has been reduced to writing at the time of notification. Any increase in the scope of work which increases the dollar value of the contract, whether or



not such change is within the scope of work designated for performance by an MBE or WBE under any subcontract, shall be contemporaneously submitted to the DSBO. Those changes to the scope of work that cannot be performed by existing project participants (the Contractor, subcontractors, suppliers, etc.) shall be subject to a goal for MBEs and WBEs equal to the original committed goal. The Contractor shall satisfy the goal for the changed scope of work by soliciting new MBEs or WBEs in accordance with § 28-60, D.R.M.C, and it must show each element of modified good faith that is stated in § 28-75(c), D.R.M.C. The Contractor shall provide to the Director the documentation described in § 28-75(c) with respect to the increased dollar value of the contract.

- G. The Contractor will comply with the provisions of § 28-75 as to the replacement of a WBE or MBE on the Project.
- H. The Contractor acknowledges that it has a continuing duty, under D.R.M.C. §§ 28-72, 28-73, and 28-75, to maintain, throughout the duration of the contract, compliance with the level of MBE and WBE participation committed to under any approved compliance plan, and that such commitment is a material condition of the Contract.

## **SECTION 6: COMPLIANCE DOCUMENTS AND REPORTING**

- A. The Contractor will submit the following documentation, properly completed and submitted monthly or when otherwise required by DSBO.
  - 1. Prime contractor background information form\*
  - 2. DSBO Schedule of Work form\*
  - 3. Subcontractor background information form for all subcontractors\*
  - 4. M/WBE Letters of Intent
  - 5. Monthly contractor's certification of payment forms (participation report)
  - 6. DSBO change order forms
  - 7. M/WBE final lien release forms
  - 8. B2G online payment verification

(\*due at NTP + 5 days; revisions as required)

- B. The Contractor will document its progress in seeking and obtaining M/WBE participation as required by DSBO. Records of the Contractor's efforts to solicit M/WBE subcontractor and supplier participation, will be maintained and reported monthly to DSBO, or as otherwise required, including:
  - 1. Dates of solicitation
  - 2. Names, addresses and telephone numbers of all M/WBE firms contacted.
  - 3. Description of efforts made to contact M/WBE firms.
  - 4. Description of information provided to M/WBE firms.
  - 5. Description of the process and outcome.

6. Advertisements soliciting bids from M/WBE firms in local community publications or construction industry related publications.
7. Schedules of prebid meetings to inform M/WBE and non-M/WBE subcontractors and suppliers of opportunities to participate.
8. Evidence that the Contractor provided M/WBE subcontractors and suppliers necessary access to and adequate time to review all project documents.
9. All other documentation required to establish the Contractor's compliance with the good faith efforts required by City ordinance, specifically the items enumerated in subsections 28-62(b)(2) through 28-62(b)(10). D.R.M.C.

## **SECTION 7: PLAN ADMINISTRATION; MONITORING; CLOSEOUT**

- A. DSBO shall have prompt, full and complete access to all Contractor and subcontractor personnel, books and records required to monitor and assure performance of this Compliance Plan.
- B. The Contractor's personnel identified in Section 2 above, will be responsible for administering and monitoring the Contractor's performance of this Compliance Plan.
- C. Actual M/WBE participation will be calculated in accordance with the M/WBE Ordinance, including § 28-63, D.R.M.C., and applicable Rules. The Contractor will submit to DSBO a monthly tracking report demonstrating the M/WBE participation that has been achieved.
- D. The Contractor acknowledges that the City may impose monetary penalties and/or withhold payment in the event of Contractor's non-compliance with the M/WBE Ordinance and this Compliance Plan.
- E. The Contractor will use the following methodology for final reconciliation of M/WBE participation performance achieved during the Contract term, measured against the established project goal. The Contractor will present copies of all signed DSBO Final Lien Release forms for MWBE firms utilized for participation on the Contract. DSBO will compare the Final Monthly Participation Report submitted by the Contractor to determine if the Final Lien Release dollar figures match what is contained within the Final Monthly Participation Report. Final Compliance shall be achieved when the Contractor establishes to the Director's satisfaction, that it has remitted payments to M/WBE firms utilized on the Project; that it utilized M/WBE firms in accordance with each such firm's Letter of Intent; and that the amount of payments to M/WBE firms equals or exceeds the assigned M/WBE goal for the total amount of the Contract. Failure to achieve final compliance may subject the Contractor to sanctions, in accordance with D.R.M.C, Section 28-77. As provided in such ordinance, sanctions may include, but are not limited to, assessment by the Director of a monetary penalty against the Contractor in an amount not more than 150% of the contract amount for each MBE or WBE involved. Any such monetary penalty leveled by the Director shall be withheld from the final payment due to the Contractor, and any amount that remains due and owing to the City

may be collected pursuant to D.R.M.C., Section 28-77. The Contractor may seek review of any such determination by the Director to levy sanctions through the dispute resolution process set forth in the Construction Contract.

## **SECTION 8: NON-COMPLIANCE; SANCTIONS; REMEDIATION PLAN**

- A. At all times, DSBO shall monitor the Contractor's compliance with this Plan and the M/WBE Ordinance and Rules. The Contractor shall fully cooperate with DSBO's compliance monitoring and auditing efforts, including DSBO's investigation of any alleged or suspected non-compliance by the Contractor.
- B. If the Director has reason to believe that the Contractor is not in compliance with this Plan or with the M/WBE Ordinance, the Director shall give the Contractor written notice of non-compliance, citing the reasons why the Contractor is not in compliance, and giving the Contractor thirty (30) days in which to submit a remediation plan for the Director's review and acceptance. The remediation plan shall demonstrate how the Contractor will cure such non-compliance, and if such non-compliance consists of failure to obtain or maintain M/WBE participation at the committed level, that the Contractor's M/WBE participation level will again achieve the committed level, and that the Contractor will ultimately achieve the committed participation goal for the contract.
- C. The Contractor shall, within such thirty (30) day period, deliver to the Director a written remediation plan the Director's review and approval.
- D. The Director may issue a written determination of non-compliance and the sanction which the Director has elected to impose as a consequence:
  - (1) If the Contractor does not respond within the time allowed; or
  - (2) If the Contractor fails to submit a satisfactory remediation plan; or
  - (3) If a Contractor submits an acceptable remediation plan but thereafter fails to comply with the plan.
- E. The Contractor may contest a determination issued under Section 8(D), by requesting a hearing within 30 days after the date of such determination, as provided in § 28-33, D.R.M.C.

## **SECTION 9: MEDIATION**

The Contractor will provide a process to resolve disputes that occur between a MBE or WBE and any non-M/WBE subcontractors or suppliers under the Contract. The Contractor will document such disputes and inform DSBO of the steps the Contractor plans to take to resolve the dispute. The Contractor may ask DSBO to assist in the resolution process it has developed. The

Contractor will document and notify DSBO if those disputes have been resolved and inform DSBO of any disputes it was unable to resolve. DSBO will notify the Contractor of any complaints received by DSBO from M/WBE firms regarding a dispute they are experiencing with either a subcontractor or the Contractor.

IN WITNESS WHEREOF, Contractor has executed and agrees to abide by the terms of this Compliance Plan as of the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Contractor

By:\_\_\_\_\_

## ATTACHMENT 1

### EXCERPTS FROM DENVER REVISED MUNICIPAL CODE

#### *Sections 28-62(b) and 28-75(c), D.R.M.C*

#### **Sec. 28-62. Same--Good faith efforts.**

(b) The statement of good faith efforts shall include a specific response and verification with respect to each of the following good faith effort categories, which may be further defined by rule or regulation. A bidder or proposer may include any additional information it believes may be relevant. Failure of a bidder or proposer to show good faith efforts as to any one (1) of the following categories shall render its overall good faith effort showing insufficient and its bid or proposal non-responsive:

- (1) If prebid or preselection meetings are scheduled by the city at which MBEs and WBEs may be informed of subcontracting or joint venture opportunities under a proposed contract to be bid, or procured pursuant to the competitive selection process, attendance at such prebid or preselection meetings is not mandatory; however, bidders and proposers are responsible for the information provided at these meetings.
- (2) The bidder or proposer must solicit through all reasonable and available means, the interest of all MBEs and WBEs certified in the scopes of work of the contract. The bidder or proposer must solicit the interest of such MBEs and WBEs within sufficient time, prior to the bid opening or date of final project-specific proposal in the case of a competitive selection process, to allow such MBEs and WBEs to respond to the solicitation. The bidder or proposer must determine with certainty if the MBEs and WBEs are interested by demonstrating appropriate steps to follow up initial solicitations.
- (3) The bidder or proposer must select portions of the work of the contract to be performed by MBEs and WBEs in order to increase the likelihood that the project goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate MBE and WBE participation as subcontractors or joint venturers, and for bidder or proposer self-performed work, as suppliers, manufacturers, manufacturer's representatives and brokers, all reasonably consistent with industry practice, even when the bidder or proposer would otherwise prefer to perform these work items with its own forces. The bidder or proposer must identify what portions of the contract will be self-performed and what portions of the contract will be opened to solicitation of bids, proposals and quotes from MBE and WBEs. All portions of the contract not self-performed must be solicited for MBE and WBE participation. The ability or desire of a bidder or proposer to perform the work of a contract with its own forces does not relieve the bidder or proposer of the responsibility to meet the project goal or demonstrate good faith efforts to do so.
- (4) The bidder or proposer, consistent with industry practice, must provide MBEs and WBEs at a clearly stated location with timely, adequate access to and information about the plans, specifications, and requirements of the contract, including bonding and insurance requirements, if any, to assist them in responding to a solicitation.

- (5) The bidder or proposer must negotiate in good faith with interested MBEs and WBEs and provide written documentation of such negotiation with each such MBE or WBE.
- (6) For each MBE or WBE which contacted the bidder or proposer or which the bidder or proposer contacted or attempted to subcontract or joint venture with, consistent with industry practice, the bidder or proposer must supply a statement giving the reasons why the bidder or proposer and the MBE or WBE did not succeed in negotiating a subcontracting, supplier, manufacturer, manufacturer's representative, broker or joint venture agreement, as applicable.
- (7) The bidder or proposer must provide verification that it rejected each non-utilized MBE and WBE because the MBE or WBE did not submit the lowest bid or it was not qualified. Such verification shall include a verified statement of the amounts of all bids received from potential or utilized subcontractors, suppliers, manufacturers, manufacturer's representatives, brokers or joint venturers on the contract, whether or not they are MBEs or WBEs. In making such a determination of not being qualified, the bidder or proposer shall be guided by the definition of qualified in section 28-54(42), but evidence of lack of qualification must be based on factors other than solely the amount of the MBE's or WBE's bid. For each MBE or WBE found not to be qualified by the bidder or proposer, the verification shall include a statement giving the bidder's or proposer's reasons for its conclusion. A bidder's or proposer's industry standing or group memberships may not be the cause of rejection of an MBE or WBE. A bidder or proposer may not reject an MBE or WBE as being unqualified without sound reasons based on a reasonably thorough investigation and assessment of the MBE's or WBE's capabilities and expertise.
- (8) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining bonding, lines of credit, or insurance as required by the city or by the bidder or proposer, provided that the bidder or proposer need not provide financial assistance toward this effort.
- (9) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining necessary and competitively priced equipment, supplies, materials, or related assistance or services for performance under the contract, provided that the bidder or proposer need not provide financial assistance toward this effort.
- (10) The bidder or proposer must use the DSBO MBE/WBE directories to identify, recruit, and place MBEs and WBEs.

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**Sec. 28-75. Potential violations during contract performance.**

**(c) The following modified good faith requirements shall apply to sections 28-72 and 28-73. In the event that a contractor or consultant must add or replace an MBE or WBE subcontractor, subconsultant, joint venturer, supplier, manufacturer, manufacturer's representative or broker or in the event that a new scope of work is added to the ongoing contract, and the contractor or consultant in such event is in non-compliance with maintenance of the original project goal upon which the contract was awarded, due to failure to utilize additional MBEs or WBEs, the following modified good faith efforts must be completed. Failure of a contractor or consultant to show**

good faith efforts as to any one (1) of the following categories shall render its overall good faith efforts showing insufficient; and its contract performance in non-compliance with this division 3.

- (1) Verification in writing to the DSBO of the contractor's or consultant's intention to terminate or replace an MBE or WBE originally identified for participation in the bid, proposal or competitive selection process proposal upon which the contract was awarded. The reason for the termination or replacement must be stated and the type of work or services must be identified.
- (2) Verification that the contractor or consultant used the most current MBE and WBE directory from the DSBO in order to contact MBEs and WBEs that are certified in the applicable area of work or supply at the time of the modified good faith effort.
- (3) Verification of efforts to contact appropriate MBEs and WBEs within the same identified subcontractor, subconsultant, joint venturer, supplier, manufacturer, manufacturer's representative or broker area must be documented. Facsimile transmission, e-mail and telephone communication will be acceptable. The director may verify such contacts as he deems appropriate.
- (4) Documentation of the modified good faith efforts must be submitted to the DSBO prior to the payment to the contractor or consultant of the next progress or other partial payment or fund release under the contract.

**CITY AND COUNTY OF DENVER  
RULES AND REGULATIONS AND BID  
CONDITIONS OF THE  
MANAGER OF PUBLIC WORKS**

**PERTAINING TO EQUAL EMPLOYMENT OPPORTUNITY  
IN THE CITY AND COUNTY OF DENVER**

APPROVED FOR LEGALITY:

APPROVED AND ADOPTED:

/s/ \_\_\_\_\_  
Attorney for the City and  
County of Denver

/s/ \_\_\_\_\_  
Manager of Public Works

Adopted and Published Pursuant to Article 111, Division 2 of Chapter 28  
the Revised Municipal Code  
of the City and County of Denver

These Rules and Regulations cancel and supersede any and all previous issued Rules and  
Regulations on the subject



**RULES AND REGULATIONS**  
**REGARDING**  
**EQUAL EMPLOYMENT OPPORTUNITY**

Promulgated and adopted by the Manager of Public Works pursuant to and by authority of Article III, Division 2, Chapter 28 of the Revised Municipal Code of the City and County of Denver, and for the purpose of insuring that contractors, subcontractors and suppliers soliciting and receiving compensation for contract work from or through the City and County of Denver provide equal opportunity in employment without regard to race, color, creed, sex, national origin, age, religion, marital status, political opinion or affiliation or mental or physical handicap and meet certain requirements for the hiring, training, promotion and treatment during employment of members of ethnic groups subjected to differential treatment, including persons of African descent (Black), Spanish-surnamed (Hispanic), Asian-American and American Indian groups.

**RULE I**  
**DEFINITIONS**

- A. "City" means the City and County of Denver.
- B. "Manager" shall mean the Manager of Public Works for the City and County of Denver.
- C. "Contract" means a contract entered into with the City and County of Denver, financed in whole or in part by local resources or funds of the City and County of Denver, for the construction of any public building or prosecution or completion of any public work.
- D. "Contractor" means the original party to a contract with the City and County of Denver, also referred to as the "general" or "prime" contractor.
- E. "Director" means the Director of the Mayor's Office of Contract Compliance.
- F. "Subcontractor" means any person company, association, partnership, corporation, or other entity which assumes by subordinate agreement some or all of the obligations of the general or prime contractor.
- G. The Phrase "Bidding Specifications" as used in Article 111, Division 2 of Chapter 28 of the Revised Municipal Code shall include BID CONDITION, INVITATION TO BID AND NOTICE OF PROPOSAL.
- H. "Affirmative Action Program" means a set of specific and result-oriented procedures or steps to which a contractor commits himself to apply every good faith effort to employ members of ethnic minority groups, to include persons of African descent (Black), Spanish surnamed (Hispanic), Asian-American, American Indians, and persons with mental or physical handicap.
- I. "Mayor's Office of Contract Compliance" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

**RULE 11**  
**NOTICE OF HEARING**

When results of conciliation efforts are unsatisfactory to the Manager and he is informed in accordance with Article III, Division 2 of Chapter 28 of the Revised Municipal Code that a contractor or subcontractor has apparently failed to meet affirmative action and equal employment opportunity requirements after a reasonable period of notice to correct deficiencies, the Manager will, prior to imposition of any sanctions, afford the general contractor a hearing in order to determine whether the contractor or his subcontractors have failed to comply with the affirmative action and equal employment opportunity requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or of the contract. Written notice of such hearing shall be delivered personally or sent by certified mail return receipt requested, to the contractor and to any subcontractor involved at least ten days prior to the date scheduled for the hearing.

**RULE III**  
**HEARING**

- A. Contractors will appear at hearings and may be represented by counsel, and may present testimony orally and other evidence.
- B. Hearings shall be conducted by one or more hearing examiners designated as such by the Manager.
- C. The Director of the Mayor's Office of Contract Compliance may participate in hearings as a witness.
- D. Hearings shall be held at the place specified in the notice of hearing.
- E. All oral testimony shall be given under oath or affirmation and a record of such proceedings shall be made.
- F. All hearings shall be open to the public.
- G. The hearing officer shall make recommendations to the Manager who shall make a final decision.

**REGULATIONS**

**REGULATION NO. 1. ORDINANCE:** The Rules and Regulations of the Manager shall be inserted in the bidding specifications for every contract for which bidding is required.

**REGULATION NO. 2. EXEMPTIONS:** Each contract and subcontract, regardless of dollar amount, shall be subject to affirmative action requirements unless specifically exempted in writing individually by the Manager. Exemptions apply only to "affirmative action" in equal

employment opportunity, and are not to be construed as condonation in any manner of "discrimination" or "discriminatory practices" in employment because of race, color, creed sex age national origin, religion, marital status, political opinion or mental or physical handicap.

**REGULATION NO. 3. DIRECTOR OF CONTRACT COMPLIANCE:** The Director of the Mayor's Office of Contract Compliance shall perform the duties assigned to such official by Article III, Division 2 of Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Mayor's Office of Contract Compliance or designated representatives shall inform bidders and contractors of affirmative action procedures, programs, and goals in accordance with the ordinance at pre-bid and pre-construction conference; (2) make regular on-site inspections; (3) supply contractors and subcontractors with report forms to be completed by them when requested, and furnished to the Director of the Mayor's Office of Contract Compliance; and (4) review payroll records, employment records and practices of general contractors and their subcontractors and suppliers during the performance of any contract. The Director of the Mayor's Office of Contract Compliance shall promptly report apparent affirmative action deficiencies to the Manager.

**REGULATION NO. 4. GOALS AND TIMETABLES:** In general, goals and timetables should take into account anticipated vacancies and the availability of skills in the market place from which employees should be drawn. In addition, where discrimination in employment by a general contractor or any of his subcontractors is indicated, a corrective action program will take into account the need by the general contractor and his subcontractors to correct past discriminatory practices and reach goals of minority manpower utilization on a timely basis through such recruiting and advertising efforts as are necessary and appropriate.

**REGULATION NO.5. AWARD OF CONTRACTS:** It shall be the responsibility of the Director of the Mayor's Office of Contract Compliance to determine the affirmative action capability of bidders, contractors and subcontractors and to recommend to the Manager the award of contracts to those bidders, contractors and subcontractors and suppliers who demonstrate the ability and willingness to comply with the terms of their contract.

**REGULATION NO. 6. PUBLICATION AND DUPLICATION:** Copies of these Rules and Regulations as amended by the Manager from time to time, shall as soon as practicable and after Notice being published will be made a part of all City Contracts.

**REGULATION NO. 7. NOTICE TO PROCEED:** Prior to issuance of Notice to Proceed a sign-off will be required of the Director of the Mayor's Office of Contract Compliance or his designee.

**REGULATION NO. 8. CONTRACTS WITH SUBCONTRACTORS:** To the greatest extent possible the contractor shall make a good faith effort to contract with minority contractors, subcontractors and suppliers for services and supplies by taking affirmative actions which include but are not limited to the following:

1. Advertise invitations for subcontractor bids in minority community news media.

2. Contact minority contractor organizations for referral of prospective subcontractors.
3. Purchase materials and supplies from minority material suppliers.

**REGULATION NO. 9. AGENCY REFERRALS:** it shall be no excuse that the union with which the contractor or subcontractor has an agreement providing for referral, exclusive or otherwise, failed to refer minority employees.

**REGULATION NO. 10. CLAUSES:** The Manager shall include the appropriate clauses in every contract and the contractor shall cause to be inserted in every subcontract the appropriate clauses:

1. **APPENDIX A:** City and County of Denver Equal Opportunity Clause-ALL CONTRACTS funded only with City & County of Denver monies.
2. **APPENDIX B:** Equal Opportunity Clause (11246)-ALL FEDERAL ASSISTED
3. **APPENDIX C:** Section 3-Assurance of Compliance-HUD ASSISTED PROJECTS.
4. **APPENDIX D:** Section 3-Clause-HUD ASSISTED PROJECTS.

All amendments to the appendices shall be included by reference.

**REGULATION NO. 11. SHOW CAUSE NOTICES:** When the Manager has reasonable cause to believe that a contractor has violated Article III, Division 2 of Chapter 28 of the Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen days why enforcement procedures, or other appropriate action to insure compliance, should not be instituted.

**REGULATION NO. 12. BID CONDITIONS-AFFIRMATIVE ACTION REQUIREMENTS-EQUAL EMPLOYMENT OPPORTUNITY:**

**1. APPENDIX E:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as amended and published by the U.S. Department of Labor, Employment Standards Administration, Office of Federal Contract Compliance, shall be inserted verbatim for bidding specification for every non-exempt contract involving the use of Federal funds.

**2. APPENDIX F:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as published by the Department of Public Works, City and County of Denver shall be inserted verbatim as bidding specifications for every non-exempt contract using City funds.

## APPENDIX A

### CITY AND COUNTY OF DENVER EQUAL OPPORTUNITY CLAUSE-ALL CONTRACTS

1. The contractor will not discriminate against any employee or applicant for employment because of race creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided, advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. Each contractor will comply with all provisions of Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and Director.
5. The contractor will furnish all information and reports required by Article III, Division 2, Chapter 28 of the Revised Municipal Code, and by rules, regulations and orders of the Manager and Director or pursuant thereto, and will permit access to his books, records, and accounts by the Manager, Director or their designee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders this contract may be cancelled, terminated., or suspended in whole or in part and the contractor may be declared ineligible for further City contracts in accordance with procedures authorized in Article III, Division 2, Chapter 28 of the Revised Municipal Code, or by rules, regulations, or order of the Manager.

7. The contractor will include Regulation 12 Paragraph 2 and the provisions of paragraphs (1) through (6) in every subcontract or purchase order unless, exempted by rules, regulations, or orders of the Manager issued pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, so that such provisions will be binding upon each subcontractor or suppliers. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.

The applicant further agrees to be bound by the above equal opportunity clauses with respect to its own employment practices when it participates in City contracts. The contractor agrees to assist and cooperate actively with the Manager and the Director in obtaining compliance of subcontractors and suppliers with the equal opportunity clause and the rules, regulations and relevant orders of the Manager, and will furnish the Manager and the Director such information as they may require for the supervision of compliance, and will otherwise assist the Manager and Director in the discharge of the City's primary responsibility for securing compliance. The contractor further agrees to refrain from entering into any contract or contract modification subject to Article III, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who has not demonstrated eligibility for, City contracts.

The contractor will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the Manager and Director. In addition, the contractor agrees that failure or refusal to comply with these undertakings the Manager may take any or all of the following actions:

- A. Cancellation, termination, or suspension in whole or in part of this contract.
- B. Refrain from extending any further assistance to the applicant under the program with respect to which the failure occurred until satisfactory assurance of future compliance has been received from such applicant.
- C. Refer the case to the City Attorney for appropriate legal proceedings.

**SUBCONTRACTS:** Each prime contractor or subcontractor shall include the equal opportunity clause in each of its subcontracts.

**APPENDIX F  
BID CONDITIONS  
AFFIRMATIVE ACTION REQUIREMENTS  
EQUAL EMPLOYMENT OPPORTUNITY**

For all Non-Exempt Construction Contracts to be Awarded by  
the City and County of Denver, Department of Public Works

**NOTICE**

EACH BIDDER, CONTRACTOR OR SUBCONTRACTOR (HEREINAFTER THE CONTRACTOR) MUST FULLY COMPLY WITH THE REQUIREMENTS OF THESE BID CONDITIONS AS TO EACH CONSTRUCTION TRADE IT INTENDS TO USE ON THIS CONSTRUCTION CONTRACT, AND ALL OTHER CONSTRUCTION WORK (BOTH CITY AND NON-CITY) IN THE DENVER AREA DURING THE PERFORMANCE OF THIS CONTRACT OR SUBCONTRACT. THE CONTRACTOR COMMITS ITSELF TO THE GOALS FOR MINORITY MANPOWER UTILIZATION, AS APPLICABLE, AND ALL OTHER REQUIREMENTS, TERMS AND CONDITION OF THESE BID CONDITIONS BY SUBMITTING A PROPERLY SIGNED BID.

THE CONTRACTOR SHALL APPOINT A COMPANY EXECUTIVE TO ASSUME THE RESPONSIBILITY FOR THE IMPLEMENTATION OF THE REQUIREMENTS, TERMS AND CONDITIONS OF THESE BID CONDITIONS.

MICHAEL D. MUSGRAVE  
Manager of Public Works  
City and County of Denver

**A. REQUIREMENTS --AN AFFIRM ATIVE ACTION PLAN:**

Contractors shall be subject to the provisions and requirements of these bid conditions including the goals and timetables for minority' and female utilization, and specific affirmative action steps set forth by the Office of Contract Compliance. The contractor's commitment to the goals for minority, and female utilization as required constitutes a commitment that it will make every good faith effort to meet such goals.

**1. GOALS AND TIMETABLES:**

The goals and timetables for minority<sup>1</sup> and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade are as follows:

**GOALS FOR MINORITY PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 21.7% - 23.5%  
Until Further Notice

**GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 6.9%  
Until Further Notice

The goals for minority and female utilization above are expressed in terms of hours of training and employment as a proportion of the total number of hours to be worked by the contractor's aggregate workforce, which includes all supervisory personnel, in each trade, on all projects for the City and County of Denver during the performance of its contract (i.e., The period beginning with the first day of work on the City and County of Denver funded construction contract and ending with the last day of work).

The hours of minority and female employment and training must be substantially uniform throughout the length of the contract in each trade and minorities and females must be employed evenly on each of a contractor's projects. Therefore, the transfer of minority or female employees from contractor to contractor or from project to project for the purpose of meeting the contractor's goals shall be a violation of these Bid Conditions.

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<sup>1</sup> "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian-Americans, and American Indians, and includes both men and Minority women.



If the contractor counts the nonworking hours of apprentices they must be employed by the contractor during the training period; the contractor must have made a commitment to employ apprentices at the completion of their training subject to the availability of employment opportunities; and the apprentices must be trained pursuant to training programs approved by the Bureau of Apprenticeship and Training.

2. **SPECIFIC AFFIRMATIVE ACTION STEPS:**

No contractor shall be found to be in noncompliance solely on account of its failure to meet its goals, but will be given an opportunity to demonstrate that the contractor has instituted all the specific affirmative action steps specified and has made every good faith effort to make these steps work toward the attainment of its goals within the timetables, all to the purpose of expanding minority and female utilization in its aggregate workforce. A contractor, who fails to comply with its obligation under the Equal Opportunity Clause of its contract and fails to achieve its commitments to the goals for minority and female utilization has the burden of proving that it has engaged in an Affirmative Action Program directed at increasing minority and female utilization and that such efforts were at least as extensive and as specific as the following:

- a. The contractor should have notified minority and female organizations when employment opportunities were available and should have maintained records of the organization's response.
- b. The contractor should have maintained a file of the names and addresses of each minority and female referred to it by any individual or organization and what action was taken with respect to each such referred individual, and if the individual was not employed by the contractor, the reasons. If such individual was sent to the union hiring hall for referral and not referred back by the union or if referred, not employed by the contractor, the file should have documented this and their reasons.
- c. The contractor should have promptly notified the Department of Public Works, and Mayor's Office of Contract Compliance when the union or unions with which the contractor has collective bargaining agreements did not refer to the contractor a minority or female sent by the contractor, or when the contractor has other information that the union referral process has impeded efforts to meet its goals.
- d. The contractor should have disseminated its EEO policy within its organization by including it in any employee handbook or policy manual; by publicizing it in company newspapers and annual reports and by advertising such policy at reasonable intervals in union publications. The EEO policy should be further disseminated by conducting staff meetings to explain and discuss the policy; by

posting of the policy; and by review of the policy with minority and female employees.

- e. The contractor should have disseminated its EEO policy externally by informing and discussing it with all recruitment sources; by advertising in news media, specifically including minority and female news media; and by notifying and discussing it with all subcontractors.
- f. The contractor should have made both specific and reasonably recurrent written and oral recruitment efforts. Such efforts should have been directed at minority and female organizations, schools with substantial minority and female enrollment, and minority and female recruitment and training organizations within the contractor's recruitment area.
- g. The contractor should have evidence available for inspection that all tests and other selection techniques used to select from among candidates for hire, transfer, promotion, training, or retention are being used in a manner that does not violate the OFCCP Testing Guidelines in 41 CFR Part 60-3.
- h. The contractor should have made sure that seniority practices and job classifications do not have a discriminatory effect.
- i. The contractor should have made certain that all facilities are not segregated by race.
- j. The contractor should have continually monitored all personnel activities to ensure that its EEO policy was being carried out including the evaluation of minority and female employees for promotional opportunities on a quarterly basis and the encouragement of such employees to seek those opportunities.
- k. The contractor should have solicited bids for subcontracts from available minority and female subcontractors engaged in the trades covered by these Bid conditions, including circulation of minority and female contractor associations.

**NOTE:** The Director and the Mayor's Office of Contract Compliance will provide technical assistance on questions pertaining to minority and female recruitment sources, minority and female community organizations, and minority and female news media upon receipt of a request for assistance from a contractor.

3. **NON-DISCRIMINATION:**

In no event may a contractor utilize the goals and affirmative action steps required in such a manner as to cause or result in discrimination against any person on account of race, color, religion, sex, marital status, national origin, age, mental or physical handicap, political opinion or affiliation.

4. **COMPLIANCE AND ENFORCEMENT:**

In all cases, the compliance of a contractor will be determined in accordance with its obligations under the terms of these Bid Conditions. All contractors performing or to perform work on projects subject to these Bid Conditions hereby agree to inform their subcontractors in writing of their respective obligations under the terms and requirements of these Bid Conditions, including the provisions relating to goals of minority and female employment and training.

A. **Contractors Subject to these Bid Conditions:**

In regard to these Bid Conditions, if the contractor meets the goals set forth therein or can demonstrate that it has made every good faith effort to meet these goals, the contractor shall be presumed to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, the implementing regulations and its obligations under these Bid Conditions. In the event, no formal sanctions or proceedings leading toward sanctions shall be instituted unless the contracting or administering agency otherwise determines that the contractor is violating the Equal Opportunity Clause.

1. Where the Office of Contract Compliance finds that a contractor failed to comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code or the implementing regulations and the obligations under these Bid Conditions, and so informs the Manager, the Manager shall take such action and impose such sanctions, which include suspension, termination, cancellation, and debarment, as may be appropriate under the Ordinance and its regulations. When the Manager proceeds with such formal action it has the burden of proving that the contractor has not met the goals contained in these Bid Conditions. The contractor's failure to meet its goals shall shift to it the requirement to come forward with evidence to show that it has met the good faith requirements of these Bid Conditions.
2. The pendency of such proceedings shall be taken into consideration by the Department of Public Works in determining whether such contractor can comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Mayor's Office of Contract Compliance shall review the contractor's employment practices during the performance of the contract. If the Mayor's Office of Contract Compliance determines that the contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

B. **Obligations Applicable to Contractors:**

It shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority or female employees. Discrimination in referral for employment, even if pursuant to provisions of a collective bargaining agreement, is prohibited by the National Labor Relations Act, as amended, Title VI of the Civil Rights Act of 1964, as amended, and Article III, Division 2, Chapter 28 of the Revised Municipal Code. It is the policy of the Department of Public Works that contractors have a responsibility to provide equal employment opportunity, if they wish to participate in City and County of Denver contracts. To the extent they have delegated the responsibility for some of their employment practices to a labor organization and, as a result, are prevented from meeting their obligations pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, such Contractors cannot be considered to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, or its implementing rules and regulations.

C. **General Requirements**

Contractors are responsible for informing their subcontractors in writing regardless of tier, as to their respective obligations. Whenever a contractor subcontracts a portion of work in any trade covered by these Bid Conditions, it shall include these Bid Conditions in such subcontracts and each subcontractor shall be bound by these Bid Conditions to the full extent as if it were the prime contractor. The contractor shall not, however, be held accountable for the failure of its subcontractors to fulfill their obligations under these Bid Conditions. However, the prime contractor shall give notice to the Director of any refusal or failure of any subcontractor to fulfill the obligations under these Bid Conditions. A subcontractor's failure to comply will be treated in the same manner as such failure by a prime contractor.

1. Contractors hereby agree to refrain from entering into any contract or contract modification subject to Article 111, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who is determined not to be a "responsive" bidder for the City and County of Denver contracts pursuant to the Ordinance.
2. The contractor shall carry out such sanctions and penalties for violation of these Bid Conditions and the Equal Opportunity Clause including suspension, termination and cancellation of existing subcontracts and debarment from future contracts as may be ordered by the Manager pursuant to Article 111, Division 2, Chapter 28 of the Revised Municipal Code and its implementing regulations.

3. Nothing herein is intended to relieve any contractor during the term of its contract from compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the Equal Opportunity Clause of its contract with respect to matters not covered in these Bid Conditions.
4. Contractors must keep such records and file such reports relating to the provisions of these Bid Conditions as shall be required by the Office of Contract Compliance.
5. Requests for exemptions from these Bid Conditions must be made in writing, with justification, to the Manager of Public Works, City and County Building, Room 379, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

Office of Economic Development Division of Small Business Opportunity 201 W Colfax Ave, Dept 907 Denver, CO 80202 P: 720.913.1714 F: 720.913.1809 www.denvergov.org/oed

Diversity and Inclusiveness\* in City Solicitations Information Request Form Denver Executive Order No. 101 establishes strategies between the City and private industry to use diversity and inclusiveness to promote economic development in the City and County of Denver and to encourage more businesses to compete for City contracts and procurements. The Executive Order requires, among other things, the collection of certain information regarding the practices of the City's contractors and consultants toward diversity and inclusiveness and encourages/requires City agencies to include diversity and inclusiveness policies in selection criteria where legally permitted in solicitations for City services or goods. Answer each question below. Missing or incomplete responses will be recorded as "no", "not applicable", or "none". A proposal or response to a solicitation by a contractor/consultant that does not include this completed form shall be deemed non-responsive and rejected.

**Business Email Address \***

stephan.smith@thyssenkrupp.com

**Enter Email Address of City and County of Denver contact person facilitating this solicitation. \***

stephan.smith@thyssenkrupp.com

**Please provide the City Agency that is facilitating this solicitation: \***

Denver International Airport

**Agency Name (if not listed above) \***

**Project Name \***

On-Call Passenger Conveyance Modernization

**Solicitation No. (Check Below if Not Applicable) \***

201734681

**Item #141**

Check Here if Solicitation No. is N/A

**Name of Your Company \***

thyssenkrupp elevator

**What Industry is Your Business? \***

Other

**If Other, Please Tell Us Your Industry: \***

Elevator Conveyance

**Address \***

7367 S. Revere Parkway, Unit 2a

**City \***

Centennial

**State**

Colorado

**Zip Code \***

80112

**Other (if not state, enter country, province, etc. here)**

United States

**Business Phone Number \***

7202743484

**Business Facsimile Number**

866-223-1667

**1. How many employees does your company employ? \***

- 1-10
- 11-50
- 51-100
- Over 100

1.1. How many of your employees are:

**Number of Full Time: \***

**Number of Part Time: \***

**2. Do you have a Diversity and Inclusiveness Program? \***

- Yes
- No

If No, and your company size is less than 10 employees continue to question 10. Complete and sign the form.

If Yes, does it address:

**2.1. Employment and retention? \***

- Yes
- No

**2.2. Procurement and supply chain activities? \***

- Yes
- No

**2.3. Customer Service? \***

- Yes
- No



**3. Provide a detailed narrative of your company's diversity and inclusiveness principles and programs. This may include, for example, (i) diversity and inclusiveness employee training programs, equal opportunity policies, and the budget amount spent on an annual basis for workplace diversity; or (ii) diversity and inclusiveness training and information to improve customer service. (If Not Applicable, please type N/A below) \***

thyssenkrupp Elevator statement of policy

equal employment (EEO) and affirmative action (AA)

Equal employment opportunity:

It is the policy of thyssenkrupp Elevator Corporation (the "Company") to provide equal employment to all persons on the basis of qualifications for the job and without regard to age, race, color, creed, national origin or ancestry, gender, sex, sexual orientation, gender identity or expression, religion, physical or mental disability, medical condition, pregnancy, marital status, veteran status, genetic information or characteristics, or any other status protected by Federal, State and Local laws. This policy shall cover all actions and decisions affecting an individual's employment, including but not limited to hiring, promotion, demotion, transfer, selection for training, recruitment, layoff or termination and compensation. The Company is committed to the principles of freely chosen employment, child labor avoidance, fair working hours, freedom of association, compliance with wage and hour laws, and humane treatment.

If you have a question or concern regarding EEO, contact any Human Resources manager. Any employee willfully violating this policy may be subject to appropriate disciplinary action, up to and including termination.

Pay transparency policy:

The Company will not discharge or in any other manner discriminate against employees or applicants because they have inquired about, discussed, or disclosed their own pay or the pay of another employee or applicant. However, employees who have access to the compensation information of other employees or applicants as a part of their essential job functions cannot disclose the pay of other employees or applicants to individuals who do not otherwise have access to compensation information, unless the disclosure is (a) in response to a formal complaint or charge, (b) in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or (c) consistent with the Company's legal duty to furnish information.

Affirmative action policy:

Elevator Technology  
Human Resources

10.01.2016  
Page 1/2

As a federal government contractor, in accordance with applicable laws, regulations, and Executive Orders, thyssenkrupp Elevator Corporation is required to develop annual written Affirmative Action Plans (AAPs) and is committed to employ and advance in employment qualified minorities, women, individuals with disabilities, and protected veterans (including but not limited to, disabled veterans, recently separated veterans, Armed Forces service medal veterans, and active duty wartime or campaign badge veterans).

The Chief Human Resources Officer or his/her designee serves as the Company's affirmative

action officer. Should you have questions regarding our AAPs or wish to view the available portions of the plans, please contact your Human Resources business partner to schedule an appointment during regular business hours.

**4. Does your company regularly communicate its diversity and inclusiveness policies to employees? \***

- Yes  
 No

**If you answered Yes to Question 4, how does your company regularly communicate its diversity and inclusiveness policies to employees? (Select all that apply) \***

- Employee Training  
 Pamphlets  
 Public EEO Postings  
 Other

**5. How often do you provide training and diversity and inclusiveness principles? \***

- Monthly  
 Quarterly  
 Annually  
 N/A  
 Other

**5.1 What percentage of the total number of employees generally participate? \***

- 0-25%  
 26-50%  
 51-75%  
 76-100%  
 N/A

**6. State how you achieve diversity and inclusiveness in supply and procurement activities. This may include, for example, narratives of training programs, equal opportunity policies, diversity or inclusiveness partnership programs, mentoring and outreach programs, and the amount and description of budget spent on an annual basis for procurement and supplier diversity and inclusiveness. (If Not Applicable, please type N/A below) \***

See answer to question 3 above.

**7. Do you have a diversity and inclusiveness committee? \***

- Yes  
 No

**7.1 If Yes, how often does it meet? \***

- Monthly  
 Quarterly  
 Annually  
 Other

**7.2. If you responded that you do not have a diversity and inclusiveness committee, describe any plans your company may have to establish such a committee. (If Not Applicable, please type N/A below) \***

**8. Do you have a budget for diversity and inclusiveness efforts? \***

- Yes
- No

**9. Does your company integrate diversity and inclusion competencies into executive/manager performance evaluation plans? \***

- Yes
- No

**10. If you responded that you do not have a diversity and inclusiveness program, describe any plans your company may have to adopt such a program. \***

**11. Would you like information detailing how to implement a Diversity and Inclusiveness program? \***

- Yes
- No

If yes, please email XO101@denvergov.org.

**I attest that the information represented herein is true, correct and complete, to the best of my knowledge. \***

Check Here if the Above Statement is True.

**Name of Person Completing Form \***

Stephan Smith

**Today's Date**

10-18-2017

**NOTE: Attach additional sheets or documentation as necessary for a complete response.**

\*"Diversity and inclusiveness program" means a program that invites values, perspectives and contributions of people from diverse backgrounds, and integrates diversity into its hiring and retention policies, training opportunities, and business development methods to provide an equal opportunity for each person to participate, contribute, and succeed within the organization's workplace. "Diversity" encompasses a wide variety of human differences, including differences such as race, age, gender, gender identity, sexual orientation, ethnicity, physical disabilities, appearance, historically underutilized and disadvantaged persons, as well as social identities such as religion, marital status, socio-economic status, lifestyle, education, parental status, geographic background, language ability, and veteran status."

**EQUAL OPPORTUNITY REPORT STATEMENT**

The Proposer shall review, complete, sign and submit with its proposal this Equal Opportunity Report Statement (Statement). A proposal may be considered unresponsive and may be rejected, in the City's sole discretion, if the Proposer fails to provide the fully executed Statement or fails to furnish required data. The Proposer shall also, prior to award, furnish such other pertinent information regarding its own employment policies and practices as well as those of its proposed subcontractors as the FAA, the Owner or the Executive Vice Chairman of the President's Committee may require.

The Proposer shall furnish similar Statements executed by each of its first-tier and second-tier subcontractors and shall obtain similar compliance by such subcontractors before awarding subcontracts. No subcontract shall be awarded to any non-complying subcontractor.

**Equal Opportunity Report Statement as Required in 41 CFR 60-1.7(b)**

The Proposer shall complete the following statements by checking the appropriate blanks. Failure to complete these blanks may be grounds for rejection of Proposal:

1. The Proposer has  X  has not   developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-1.40 and 41 CFR 60-2.
2. The Proposer has  X  has not   participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 11246, as amended.
3. The Proposer has  X  has not   filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).
4. The Proposer does  X  does not   employ fifty (50) or more employees.

Dated: 10-18-17

thyssenkrupp Elevator Corporation

(Name of Proposer)

By: 

Title: Regional President

**CERTIFICATION OF NON-SEGREGATED FACILITIES**

The Proposer must certify that it does not maintain or provide for its employees any segregated facilities at any of its establishments and that it does not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Proposer certifies further that it will not maintain or provide for its employees segregated facilities at any of its establishments and that it will not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The Proposer agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion or national origin because of habit, local custom or any other reason. The Proposer agrees that (except where it has obtained identical certification from proposed subcontractors for specific time period) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding Ten Thousand Dollars (\$10,000) which are not exempt from the provisions of the equal opportunity clause and that it will retain such certification in its files.

DATED: 10-18-17

thyssenkrupp Elevator Corporation

(Name of Proposer)

By: 

Title: Regional President

## EXHIBIT G



**DENVER**  
THE MILE HIGH CITY

### Office of Human Resources

Denver's Human Resource Agency

201 W. Colfax, Department 412

Denver, CO 80202

p: 720.913.5751

f: 720.913.5720

[www.denvergov.org/humanresources](http://www.denvergov.org/humanresources)

TO: All Users of the City of Denver Prevailing Wage Schedules  
FROM: Susan Keller, Human Resources Technician II  
DATE: Friday, May 26, 2017  
SUBJECT: Latest Change to Prevailing Wage Schedules

Please be advised, prevailing wage rates for some building, heavy, and highway construction trades have not been updated by the United States Department of Labor (DOL) since March 1, 2002. The Career Service Board, in their meeting held on April 21, 2011, approved the use of the attached supplemental wage rates until prevailing wage rates for these classifications of work are again published by the United States Department of Labor.

The attached Prevailing Wage Schedule is effective as of **Friday, May 26, 2017** and applies to the City and County of Denver for **BUILDING CONSTRUCTION PROJECTS** (does not include residential construction consisting of single family homes and apartments up to and including 4 stories) in accordance with the Denver Revised Municipal Code, Section 20-76(c).

General Wage Decision No. CO170030  
Superseded General Decision No. CO20160030  
Modification No. 7  
Publication Date: 5/26/17  
(4 pages)

Unless otherwise specified in this document, apprentices shall be permitted only if they are employed pursuant to, and individually registered in, a bona fide apprenticeship program registered with the U.S. Department of Labor (DOL). The employer and the individual apprentice must be registered in a program, which has received prior approval, by the DOL. Any employer, who employs an apprentice and is found to be in violation of this provision, shall be required to pay said apprentice the full journeyman scale.

For questions call (720) 913-5726.

Attachments as listed above.

General Decision Number: CO170030 05/26/2017 CO30

Superseded General Decision Number: CO20160030

State: Colorado

Construction Type: Building

County: Denver County in Colorado.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at [www.dol.gov/whd/govcontracts](http://www.dol.gov/whd/govcontracts).

| Modification Number | Publication Date |
|---------------------|------------------|
| 0                   | 01/06/2017       |
| 1                   | 01/13/2017       |
| 2                   | 01/27/2017       |
| 3                   | 02/03/2017       |
| 4                   | 04/07/2017       |
| 5                   | 04/21/2017       |
| 6                   | 05/19/2017       |
| 7                   | 05/26/2017       |

ASBE0028-002 07/01/2016

|                                                                                                               | Rates    | Fringes |
|---------------------------------------------------------------------------------------------------------------|----------|---------|
| ASBESTOS WORKER/HEAT & FROST<br>INSULATOR - MECHANICAL (Duct,<br>Pipe & Mechanical System<br>Insulation)..... | \$ 29.73 | 13.93   |

CARP0055-002 11/01/2016

|                                          | Rates    | Fringes |
|------------------------------------------|----------|---------|
| CARPENTER (Drywall Hanging<br>Only)..... | \$ 26.25 | 8.64    |

CARP1607-001 06/01/2016

Rates Fringes



MILLWRIGHT.....\$ 31.38 12.70

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ELEC0068-012 01/01/2017

Rates Fringes

ELECTRICIAN (Includes Low Voltage Wiring).....\$ 33.85 14.09

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ELEV0025-001 01/01/2017

Rates Fringes

ELEVATOR MECHANIC.....\$ 42.35 31.58

FOOTNOTE:

a. Vacation: 6%/under 5 years based on regular hourly rate for all hours worked. 8%/over 5 years based on regular hourly rate for all hours worked.

b. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.

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ENGI0009-017 10/23/2013

Rates Fringes

POWER EQUIPMENT OPERATOR (Crane)

141 tons and over.....\$ 25.97 9.15  
50 tons and under.....\$ 24.88 9.15  
51 to 90 tons.....\$ 25.04 9.15  
91 to 140 tons.....\$ 25.19 9.15

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IRON0024-009 05/01/2017

Rates Fringes

IRONWORKER, ORNAMENTAL.....\$ 26.30 12.25

-----  
IRON0024-010 05/01/2017

Rates Fringes

IRONWORKER, STRUCTURAL.....\$ 26.30 12.25

-----  
PAIN0079-006 08/01/2016

Rates Fringes

PAINTER (Brush, Roller and Spray; Excludes Drywall Finishing/Taping).....\$ 20.00 7.91

-----  
PAIN0079-007 08/01/2016

|                             | Rates    | Fringes |
|-----------------------------|----------|---------|
| DRYWALL FINISHER/TAPER..... | \$ 21.05 | 7.91    |

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PAIN0419-001 07/01/2016

|                                             | Rates    | Fringes |
|---------------------------------------------|----------|---------|
| SOFT FLOOR LAYER (Vinyl and<br>Carpet)..... | \$ 20.00 | 10.83   |

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PAIN0930-002 07/01/2016

|              | Rates    | Fringes |
|--------------|----------|---------|
| GLAZIER..... | \$ 31.02 | 8.62    |

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\* PLUM0003-009 06/01/2016

|                                                                  | Rates    | Fringes |
|------------------------------------------------------------------|----------|---------|
| PLUMBER (Excludes HVAC Duct,<br>Pipe and Unit Installation)..... | \$ 34.23 | 15.29   |

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\* PLUM0208-008 06/01/2016

|                                                                                                      | Rates    | Fringes |
|------------------------------------------------------------------------------------------------------|----------|---------|
| PIPEFITTER (Includes HVAC<br>Pipe and Unit Installation;<br>Excludes HVAC Duct<br>Installation)..... | \$ 32.90 | 16.62   |

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SFCO0669-002 04/01/2017

|                                            | Rates    | Fringes |
|--------------------------------------------|----------|---------|
| SPRINKLER FITTER (Fire<br>Sprinklers)..... | \$ 36.73 | 20.47   |

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SHEE0009-004 07/01/2016

|                                                                                                              | Rates    | Fringes |
|--------------------------------------------------------------------------------------------------------------|----------|---------|
| SHEET METAL WORKER (Includes<br>HVAC Duct Installation;<br>Excludes HVAC Pipe and Unit<br>Installation)..... | \$ 32.56 | 15.96   |

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SUCO2013-006 07/31/2015

|                 | Rates    | Fringes |
|-----------------|----------|---------|
| BRICKLAYER..... | \$ 21.96 | 0.00    |

CARPENTER (Acoustical Ceiling

|                                                                                                                    |          |      |
|--------------------------------------------------------------------------------------------------------------------|----------|------|
| Installation Only).....                                                                                            | \$ 22.40 | 4.85 |
| CARPENTER (Metal Stud<br>Installation Only).....                                                                   | \$ 17.68 | 0.00 |
| CARPENTER, Excludes<br>Acoustical Ceiling<br>Installation, Drywall<br>Hanging, and Metal Stud<br>Installation..... | \$ 21.09 | 6.31 |
| CEMENT MASON/CONCRETE FINISHER...                                                                                  | \$ 20.09 | 7.03 |
| LABORER: Common or General.....                                                                                    | \$ 14.49 | 5.22 |
| LABORER: Mason Tender - Brick...                                                                                   | \$ 15.99 | 0.00 |
| LABORER: Mason Tender -<br>Cement/Concrete.....                                                                    | \$ 16.00 | 0.00 |
| LABORER: Pipelayer.....                                                                                            | \$ 16.96 | 3.68 |
| OPERATOR:<br>Backhoe/Excavator/Trackhoe.....                                                                       | \$ 20.78 | 5.78 |
| OPERATOR: Bobcat/Skid<br>Steer/Skid Loader.....                                                                    | \$ 19.10 | 3.89 |
| OPERATOR: Grader/Blade.....                                                                                        | \$ 21.50 | 0.00 |
| ROOFER.....                                                                                                        | \$ 16.56 | 0.00 |
| TRUCK DRIVER: Dump Truck.....                                                                                      | \$ 17.34 | 0.00 |
| WATERPROOFER.....                                                                                                  | \$ 12.71 | 0.00 |

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

**Office of Human Resources**  
**Supplemental rates**  
**(Specific to the Denver projects)**  
**Supp #101, Date: 11-28-2016**

| <b><u>Classification</u></b>                    |                                  | <b><u>Base</u></b> | <b><u>Fringe</u></b> |
|-------------------------------------------------|----------------------------------|--------------------|----------------------|
| Boilermakers                                    |                                  | \$30.97            | \$21.45              |
| Iron Worker, Reinforcing                        |                                  | \$18.49            | \$3.87               |
| Journeyman Tile Setter                          |                                  | \$26.83            | \$8.48               |
| Laborers: Concrete Saw                          |                                  | \$13.89            | -                    |
| Paper Hanger                                    |                                  | \$20.15            | \$6.91               |
| Plasters                                        |                                  | \$24.60            | \$12.11              |
| Plaster Tenders                                 |                                  | \$10.79            | -                    |
| Power Equipment Operators<br>(Concrete Mixers): |                                  |                    |                      |
|                                                 | Less than 1 yd                   | \$23.67            | \$10.67              |
|                                                 | 1 yd and over                    | \$23.82            | \$10.68              |
| Power Equipment Operators:                      |                                  |                    |                      |
|                                                 | Loader up to and incl 6 cu<br>yd | \$23.67            | \$10.67              |
|                                                 | Motor Grader                     | \$23.97            | \$10.70              |
|                                                 | Roller                           | \$23.67            | \$10.67              |
|                                                 | Drillers                         | \$23.97            | \$10.70              |
|                                                 | Loaders over 6 cu yd             | \$23.82            | \$10.68              |
|                                                 | Oilers                           | \$22.97            | \$10.70              |
|                                                 | Mechanic                         | \$18.48            |                      |
|                                                 |                                  |                    |                      |
| Tile Finisher-Floor Grinder-<br>Base Grinder    |                                  | \$20.87            | \$8.42               |
| Truck Drivers                                   | Flatbed                          | \$19.14            | \$10.07              |
|                                                 | Semi                             | \$19.48            | \$10.11              |

- Caulkers—Receive rate prescribed for craft performing operation to which caulking is incidental .i.e. glazier, painter, brick layer, cement mason.
- Use the “Carpenters, Excludes Acoustical Ceiling Installation, Drywall Hanging, and Metal Stud Installation” rates published by the Federal Davis-Bacon rates for batt insulation, pre-stress concrete and tilt up concrete walls.
- Use the “Laborer—Common”, for General Housekeeping, Demolition, Final Cleanup and Indoor Fence Installer.
- Trade classification workers cannot be classified as common laborers for performing incidental cleanup from the installation of their craft. Common Laborers perform final cleanup of the entire jobsite.
- Go to [www.denvergov.org/Auditor](http://www.denvergov.org/Auditor) to view the Prevailing Wage Clarification Document.
- See Denver City Auditor’s Office Prevailing Wage Clarification of Determinations for a list of complete classification used at [Denvergov.org/Auditor](http://Denvergov.org/Auditor).

## SECTION 011100 - SUMMARY OF WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY AND DESCRIPTION

- A. The Work specified in this contract consists of furnishing all management, supervision, labor, materials, tools, equipment, services, testing and incidentals for the construction of the Work indicated in the contract documents including lump sum items and unit price items.
- B. The Work in this Contract may affect operations at DEN. The Contractor shall bid, plan and execute the Work to minimize disruption of operations and inconvenience to the public.
- C. Change Notice:
  - 1. The Contractor will be required to submit a proposal for each Change Notice
  - 2. The Contractor shall submit a proposal for the complete scope of the Work within the specified duration identified by the Notice. Where there is no time requirement identified by the notice documents, the Contractor shall submit a proposal within 20 days of receiving the notice or as allowed in Title 11 - Changes in the Work, Contract Price, or Contract Time of the General Contract Conditions, 2011 Edition.
  - 3. The proposal could contain both competitive bid and estimated costs and shall adhere to the requirements of Title 11 of the General Contract Conditions.
  - 4. The Contractor shall not proceed on any change notice work until a change order is issued.
- D. Change Directives:
  - 1. The DEN Project Manager may issue Change Directive(s) for a Scope of Work. The Contractor shall keep all Time and Material record for any Change Directive(s) issued until a final settlement for the task is settled and finalized in a Change Order.
  - 2. The Contractor shall keep records and approvals for all Time and Material impacts of a Change Directive until a final settlement is reached and fully executed by the DEN Project Manager.
  - 3. The Contractor may invoice for a Change Directive in accordance with Title 11 of the General Contract Conditions, 2011 Edition.
- E. Guaranteed Maximum Price (GMP): For Contracts assigned as GMP the Contractor

shall follow the Special Conditions issued for the Contract.

- F. This Project will be administered using the current Project Information Management System (PMIS). The application will be supplied by DEN at no cost to the Contractor. DEN will provide PMIS training for up to two (2) of the contractor's personnel.
- G. The Contractor shall participate in a preconstruction coordination meeting and update the existing BIM Project Execution Plan or prepare a BIM Project Execution Plan if one does not exist based upon the DEN BIM Project Execution Plan (BXP) template included as provided by the DEN BIM group and the coordination meeting instructions.
- H. DEN utilizes several programs as part of the Asset Management System. Keeping accurate as-built record and operation and maintenance data are essential in the integrity and the validity of the airport operation. The Contractor is required to make every effort to keep the airport data informed, updated and accurate in the format required by DEN Project Manager:
1. The Contractor shall provide and implement BIM Project Execution Plan based on the DEN BIM Project Execution Plan. The Contractor shall employ or contract a consultant to provide all the requirements to produce the Project model in the latest edition of the Current version of DEN BIM Design Standards Manual
  2. The Contractor shall comply with all the requirements of DEN BIM Project Execution Plan and provide the data to DEN to produce the complete record of the BIM model of the Project
- I. Inspection Requirements:
1. Special Inspection and Testing required by the building official or the Engineer of Record in the Contract Documents or in the Statement of Special Inspections will be performed by DEN contracted Agencies.
  2. Contractor shall subcontract Qualified Material Testing Agency(s) to perform all necessary Quality Control, processing control and any additional Testing required by the Contract Documents.
  3. DEN Quality Assurance Manager may audit all material tests performed by the Contractor Quality Control at any time. Testing and Inspections for structural elements [**reinforced concrete, steel, masonry caissons, fire protection, precast and post tension concrete**] not identified as special inspection will be performed by the Contractor Quality Control Program and Contractor Material Testing Agency and audited and confirmed by DEN Quality Assurance Manager. DEN will perform 100% visual inspection on all weldments. DEN will perform Quality Assurance testing at a frequency of approximately 10% of the Quality Control test and inspection frequencies. The testing frequencies by DEN may escalate to higher percentages and the Contractor will be responsible for all costs associated with failing tests of the same pay item elements. The Contractor may not hire the DEN contracted or testing agency in any capacity on this Project.
- J. DEN Quality Assurance will perform all quality assurance pull and adhesion tests on all airfield joint sealants. Contractor shall perform all quality control tests for the same items.

- K. DEN Quality Assurance is required to submit a letter indicating that all Work performed on the project complies with all applicable codes. The Contractor shall make sure that all required test frequencies and all deficiencies has been corrected to comply with all applicable codes standards and the requirements of the Contract Documents.

### 1.3 WORK BY OTHERS AND FUTURE WORK

- A. Refer to Title 7 – Cooperation, Coordination and Rate of Progress of the General Contract Conditions, 2011 Edition

### 1.4 SITE CONDITIONS

- A. Refer to Title 14 – Site Conditions of the General Contract Conditions, 2011 Edition

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### 3.1 CONTRACTOR'S DUTIES

- A. Refer to Title 3 – Contractor Performance and Services of the General Contract Conditions, 2011 Edition
- B. Execute the Work as specified and in a timely manner. Submit a schedule of Work that will be performed at times other than during the eight-hour working day of Monday through Friday, daylight hours. Submit this schedule five (5) working days prior to the beginning of Work to the DEN Project Manager for review and acceptance. Approval to work at night may be obtained after Contractor presents a written program outlining special precautions to be taken to control the extraordinary hazards presented by night work. That program shall include, but not limited to, supplementary lighting of work areas, availability of medical facilities, security precautions, and noise limitations.

### 3.2 COORDINATION

- A. Coordinate execution of the Work with those public utilities, governmental bodies, private utilities and other contractors performing work on and adjacent to the worksites. Eliminate or minimize delays in the Work and conflicts with those utilities, bodies, and contractors. Schedule governmental, private utility and public utility work that relies upon survey points, lines and grades established by the Contractor to occur immediately after those points, lines and grades have been established. Confirm coordination measures for each individual case with the DEN Project Manager in writing.
- B. In the coordination effort of work by others, the Contractor shall obtain and refer to equipment locations and other layouts, as available, to avoid interface problems.

- C. The City reserves the right to permit access to the site of the Work for the performance of work by other contractors and persons at such times that the City deems proper. The exercise of such reserved right shall in no way or to any extent relieve the Contractor from liability for loss and damage to the Work due to or resulting from its operations or from responsibility for complete execution of the Contract. The Contractor shall cooperate with other contractors and persons in all matters requiring common effort.

### 3.3 CONTRACTOR USE OF WORK SITE

- A. Confine work site operations to areas permitted by law, ordinances, permits, and the Contract.
- B. Consider the safety of the Work and that of the people and property on and adjacent to the work site when determining amount, location, movement, and use of materials and equipment on work site.
- C. Do not load work site with equipment and products that would interfere with the Work. Only equipment, tools, or materials required for this Work may be stored at the work site.
- D. Protect products, equipment, and materials stored on work site.
- E. Relocate stored products, equipment, and materials that interfere with operations of City, government bodies, public, and private utilities, and other contractors.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **011100**



## SECTION 011400 - WORK SEQUENCE AND CONSTRAINTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 OTHER WORK

- A. Other concurrent construction contracts with which the Contractor must interface are described elsewhere in the Contract Documents. Refer to Section 013210 "Schedule" and the Special Conditions for specific work constraints and milestones.

#### 1.3 WORK SEQUENCE

- A. The work sequence shall comply with Phasing, Sequencing, and Milestones as indicated in the Contract Documents and in accordance with the approved Construction Schedule developed by the Contractor. The schedule shall comply with requirements indicated in the Special Conditions and Section 011400 "Work Sequence and Constraints". The Construction Schedule is described in Section 013210 "Schedule".

#### 1.4 WORK CONSTRAINTS

- A. Site Constraints:
  - 1. Access to the Project shall be generally as indicated in the Contract Documents. Access shall be organized and planned by the Contractor to ensure no disruption of airline or DEN operations.
  - 2. Access to work sites will be strictly monitored and must comply with DEN Airport Operations and FAA Regulations. The Contractor shall provide monitoring and escorts as required by DEN Operations in the area of the Work.
  - 3. The Contractor's staging area will be as indicated in the Construction Documents.
  - 4. Contractor employee parking will not be allowed within the existing revenue control system. Parking facilities will be as indicated in the Construction Documents.
  - 5. Material for work in the Terminal may be brought in through the Terminal Loading Dock accessed via AOB Gate, G1 Gate 1 G7 Gate Employee and material access to the Concourses will be via Terminal or G1 Gate>.
  - 6. The Contractor shall use the haul routes specified in the Construction Documents.
  - 7. If required, the Contractor shall provide a bus and driver to transport the

Contractor's employees between the designated employee parking area and the work sites. No separate payment will be made for this bus and driver. The cost shall be included in the bid item "Mobilization". The bus driver shall be provided at all times when Contractor employees are working on the Project.

B. System Interruptions:

1. DEN is a 24/7/365 facility. Construction activity that requires any system shutdown must be coordinated with the project manager and DEN AIM MCC.
2. The Shutdown cannot proceed unless all approver groups have approved the request. If any of the groups rejects the request, you may not proceed with the Shutdown. If a Shutdown is determined to be an emergency due to pending health issues or the risk of additional damage, this process may be bypassed. If the Shutdown is an emergency, proceed with the shutdown without the approvals. Approvals must be obtained as follows
  - a. Airfield Shutdowns must be submitted at least 72 hours prior to the shutdown start date.
  - b. All other Shutdowns must be submitted at least five (5) business days prior to the shutdown start date.
  - c. All Shutdown Requests must be submitted using the Shutdown Request form, which can be accessed via the Home page of the DEN intranet.

C. Airfield Operations at Denver International Airport:

1. Full airport and aircraft operations are underway adjacent to this Project. Contractors are required to obtain a Contractor Participant Manual from the Security Manager and must follow the guidelines in the manual. Copies of the Contractor section of the manual are available for review at the Denver International Airport Access Services Office.
  - a. If any Work contains requirements for Work activities or access through or in the restricted area, reference Section 011420 "Security Requirements & Sensitive Security Information (SSI)" for requirements.
  - b. If not in a restricted area, the Contractor personnel still must be badged; reference Section 011420 "Security Requirements & Sensitive Security Information (SSI)".

D. Conduct of persons using the Denver Municipal Airport system:

1. Contractor activities shall comply with Airport Operations and Regulation 130 "TRAFFIC" and Regulation 20 "CONDUCT OF PERSONS USING THE DENVER MUNICIPAL AIRPORT SYSTEM" shall be followed at all times. These regulations are available from Airport Operations at Denver International Airport.

E. Operational safety on airports during construction:

1. All Work shall be accomplished in accordance with FAA Advisory Circular AC150/5370-2C, "Operational Safety on Airports during Construction", FAR Part 139 and FAR Part 107 except as herein modified.

F. Welding Equipment, Procedures and Constraints:

1. Natural gas-powered portable welders or inverter single- and three-phase electric portable welders are the only acceptable welding equipment to be used inside the building basement or tunnel areas. Acceptability of equipment other than the equipment noted above shall be at the sole discretion of the DEN Project Manager.
2. Welding activities inside buildings require submittal of a System Interruption Request (See paragraph "System Interruptions" above). Prior to welding in any area, the Contractor shall locate smoke detectors and shall request interruption of the fire alarm system. Subsequent to the interruption of the fire alarm system and prior to welding activities, the Contractor shall cover and protect smoke detectors until work is complete. Prior to expiration of each interruption of the system, the Contractor shall uncover the smoke detectors.
3. Electrical Service: The Contractor shall be responsible for verifying with the DEN Project Manager or representatives locations acceptable for accessing electrical power for welders and other electrical equipment feeders. The Contractor shall be responsible for all work and equipment required to install temporary or permanent electrical modifications for construction power and lighting.
  - a. Temporary Hook-up: In addition to the requirements of paragraph "Temporary Power and Lighting for Construction" below, comply with the following:
    - 1) Provide wiring sized to accommodate full load of welding equipment, accounting for voltage drop.
    - 2) Provide appropriate NEMA twist-lock or ANSI receptacle for welder hook-up.
    - 3) 480V, 3 phase, 3 pole, 4-wire twist lock ground line.
    - 4) NEMA L16-20 or ANSI C73.87.
  - b. The Contractor may not begin operation of the equipment prior to request for inspection by DEN representatives and acceptance of the installation.
  - c. Permanent installation of electrical branch circuiting for welding equipment shall be made in accordance with all Division 26 Specification Sections
4. Welding Practices: All standard safe welding practices must be followed, including but not limited to the following:
  - a. Flash protection for surrounding areas.
  - b. Contractor fire extinguisher in area.
  - c. One person in each welding area solely designated as fire watch for each welder.
  - d. Protect all equipment, cable trays and contents, etc., in area.
  - e. Use fire blankets and other appropriate materials to confine sparks and molten metal from the welding, cutting, and/or grinding activities.
  - f. All welders shall have been qualified through welding tests in accordance with applicable welding code, such as but not limited to AWS, ASME, API, within one year prior to welding taking place. Evidence of qualification shall be through Welding Performance Qualification Records (WPQR).

- g. All welder qualifications test shall be or shall have been administered and witnessed by an Independent Testing Agency (ITA), AWS Certified Welding Inspector (CWI).
  - h. If recertification of welders is required, delay costs and retesting costs shall be borne by the Contractor.
5. Grounding: Review with DEN representative's area of work prior to beginning work to ensure ground procedures do not induce undesirable charges in steel building system or other systems. This review should take place subsequent to the pre-work meeting. Do not ground to adjacent building systems, baggage system, hangers, or devices that support mechanical or electrical equipment.
- G. Temporary Power and Lighting for Construction:
- 1. The Contractor shall be responsible for all work and equipment required to install temporary or permanent electrical modifications for construction power and lighting.
  - 2. The Contractor shall be responsible for all work and equipment required to install temporary or permanent electrical modifications for construction power and lighting.
    - a. Comply with all requirements of NEC Article 590.
    - b. Flexible cords used for temporary power shall be listed in accordance with NEC Article 400, and rated for 'extra-hard' usage.
    - c. Provide an equipment grounding conductor with all temporary power circuits.
    - d. All temporary power distribution devices and equipment shall be listed and rated for the application.
    - e. Provide ground fault protection for personnel.
    - f. Temporary lighting fixtures shall be protected from physical damage.
- H. Cleaning Equipment and Spoils:
- 1. Discharge of water, liquids, or chemicals into a building sanitary sewer system or storm drainage systems is prohibited. The Contractor shall comply with all Federal, State, and Local requirements for disposal of chemicals and equipment wash water. The Contractor shall maintain and service all equipment in work areas and collect all wash water, spoils and water from excavations in containers for discharge or removal off site.
- I. Vehicle Permitting for Tunnel and Basement Use:
- 1. Electric carts require permitting. The Contractor shall provide at least one (1) electric cart for Contractor use during the work in the tunnel and basements of the buildings. Only electric or CNG powered trucks are allowed in the tunnel and basements of the buildings. Only electric or CNG trucks may be used and shall not be parked overnight or for long terms within the tunnel or basements. All vehicles require permitting. Permits may be acquired at the DEN Airport Security Office.

J. Radio and Cell Phone Use:

1. The Contractor shall have wireless communications in place prior to initiation of work in the tunnel or basements by use of cell phone and/or radio. Radio and cell phone coverage in the tunnels and basements varies in signal strength throughout the campus. An RF Application must be submitted for the Radio equipment intended for use at least 14 days prior to intended use. Include the following radio information:
  - a. Make
  - b. Model
  - c. Frequency
  - d. Effective Radiated Power (ERP)
2. Contractors must receive an approval letter from the RF Systems Manager prior to use of the radio equipment on the DEN campus.

K. Keys:

1. The Contractor shall be required to contact DEN Maintenance Control to procure keys for access to all rooms having locks in order to gain access. Keys may be checked out at the beginning of each work shift by the Contractor and shall be returned to DEN Maintenance Control at the end of each work shift

1.5 COORDINATION

- A. The Contractor will designate a contact person for coordination with the DEN Project Manager and airline tenants. The contact person shall have the authority to make decisions for the Contractor firm and shall have binding signatory power for changes in work. The contact person shall be on site at all times during work activity.
- B. No additional costs shall be considered for coordination activities throughout this project. The Contractor shall include in the Contractor's bid costs for coordination of all activities.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

3.1 DUST/PROTECTION BARRIERS

- A. HVAC system containment. The Contractor shall submit to DEN Maintenance HVAC and Fire Alarm shutdown requests prior to modifications to the area of work for dust containment. The HVAC system shall be interrupted, re-routed, or blocked off to prevent dust from entering return or supply ducts.
- B. Debris and Protection Barriers:. The Contractor shall construct code-approved and

DEN-approved dust and debris barriers on both sides of walls and doors that are to be modified. Barriers shall be constructed to allow emergency ingress and egress to and from equipment and spaces. Barriers shall be constructed to allow continual uninterrupted function of building equipment and spaces.

1. Return all removed door hardware to DEN. Label each hardware set correlating the door number of the original hardware set. Coordinate with the DEN Project Manager for storage and return of hardware.

### 3.2 EQUIPMENT

- A. Equipment: CNG-powered equipment is allowed within the buildings. No other fossil fuel equipment may be used within the buildings unless the equipment is directly vented to the building exterior.
- B. Electric: Electric powered equipment is acceptable in the Work area.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 011400

## **SECTION 011420 - SECURITY REQUIREMENTS & SENSITIVE SECURITY INFORMATION (SSI)**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 DESCRIPTION**

- A. Each Contractor is required to become a "Participant" in the DEN Airport Security Program (ASP), and must remain in good standing in order to retain Airport Security privileges.
- B. All Contractor employees and all vehicles requiring access to the Secured Area, Sterile Area, and/or any other Controlled Areas shall be required to obtain the proper access authorizations for Airport ID badges and vehicle permits.

#### **1.3 PARTICIPANT OF AIRPORT SECURITY PROGRAM**

- A. Contractors are required to become a "Participant" of the ASP. In order to become a "Participant", your company must attend a Participant meeting within the Airport Security Office.
- B. The Contractor shall comply with all Denver Municipal Airport System Rules and Regulations and all Transportation Security Administration (TSA) regulations. Special emphasis should be paid to Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program". The Denver Municipal Airport System Rules and Regulations can be found on the [flydenver.com](http://flydenver.com) website.
- C. The TSA has the authority to issue civil penalties for failure to adhere to their regulations.
- D. It is the responsibility of the Airport Security Office to ensure all fences and gates are secure. If a Contractor's operations necessitate the frequent use of a particular gate, the Contractor shall place, at the Contractor's expense, two (2) contract security guards at the gate that shall have been trained and certified by the Airport Operations Division to facilitate access to its Work. The Contractor assumes full responsibility for maintaining security once this is done. If the perimeter gate will be used as a haul route, the contractor must also place, at the Contractor's expense, Haul Route Monitors as dictated by the TSA approved Temporary Amendment. Any fines levied

against the Airport as a result of the failure by the Contractor to provide adequate security shall be passed on to the Contractor.

1. If the Contractor provides guards or monitors, the Contractor must also supply a shelter for the guards/monitors. The shelter must meet the following requirements:

a. One 10 x 12 Tuff Shed or similar type structure with a window, 24-inch convex mirror mounted outside for vehicle inspection, sufficient HVAC capability, generator, light plant, and sanitary services, which are maintained by the Contractor.

E. Contractors will be required at all times to have a supervisor or foreman at each work location in Secured, Sterile, and Controlled Areas.

F. All Work shall be accomplished in accordance with the most current FAA Advisory Circular (AC) 150/5370-2, "Operational Safety on Airports during Construction", 49 Code of Federal Regulations (CFR) Part 1542 and 14 CFR Part 139 except as modified herein.

G. All Work shall be accomplished in accordance with the most current TSA Security Directives applicable to DEN, except as modified herein.

H. This Section intends to supplement, modify, change, delete from, or add to the most current FAA AC150/5370-2. Where any paragraph, subparagraph, or clause of the AC is modified or deleted by these supplements, the unaltered provisions of that paragraph, subparagraph, or clause shall remain in effect.

#### 1.4 SENSITIVE SECURITY INFORMATION (SSI)

A. If the Contract involves SSI information or procedures, the Contractor must contact the Assistant Director of Airport Security or designee, for disclosure information, as well as protocols that must be followed with SSI distribution.

B. This Section governs the maintenance, safeguarding, and disclosure of records and information that the TSA has determined to be SSI as defined by 49 CFR Part 1520, "Protection of Sensitive Security Information". SSI is information that the TSA has determined to be detrimental to the security of Denver International Airport if disclosed to unauthorized persons. This is a process for the documentation, use, and recovery of SSI of a specific origin.

C. Applicability:

1. For all management staff, all authorized departments, all contractors, and subcontractors handling documents or materials containing SSI information.

2. Each person employed by, contracted to, or acting on behalf of the Department of Aviation at Denver International Airport is subject to the requirements of this Section.

3. SSI disclosure is limited to persons or entities under criteria identified in federal



regulations, subject to strict “need-to-know” standard, and as otherwise determined by TSA or the Department of Homeland Security (DHS).

- D. Except as otherwise provided in this Section, records containing SSI are not available for public inspection or copying. Denver International Airport will not release such records to persons without a need to know. Prime contractors will not release SSI records to any subcontractor without a need to know. An employee or contractor has a “need to know” SSI if access to the information is necessary for performance of his or her official duties.
- E. Unauthorized disclosure of SSI is a Federal violation of 49 CFR Part 1520 and violation is grounds for a civil penalty and other enforcement action by DHS Security. In addition to the civil penalties, corrective action may include issuance of an order requiring retrieval of SSI to remedy unauthorized disclosure, an order to cease future unauthorized disclosure, and dismissal from the work site.
- F. Except as otherwise provided in writing by the TSA in the interest of public safety or airport security, the following information and records containing such information constitute SSI:
1. Information that would be detrimental to the security of Denver International Airport and aviation transportation.
  2. Any performance specification, including a description of devices and procedures used by Denver International Airport, for the detection of any weapon, explosive, incendiary, or destructive substance.
  3. Any performance specification, including a description of devices and procedures, for any communications equipment used by Denver International Airport in carrying out any aviation transportation security requirements.
  4. Details of any security inspection or investigation of an alleged violation of aviation transportation security requirements of Federal law that could reveal security vulnerability.
  5. Specific details of aviation transportation security measures including those recommended by the Federal government.
  6. The following information regarding security screening under aviation transportation security requirements of Federal law:
    - a. Procedures for screening of persons, property, checked baggage, U.S. mail, and cargo.
    - b. Information used by a passenger or property-screening program or system, including an automated screening system.
    - c. Detailed information, if determined by the TSA to be SSI, about the locations at which particular screening methods or equipment are used.
    - d. Performance or test data from security equipment or screening systems.
  7. Identifying information of certain aviation transportation security personnel including lists of the names or other identifying information that identify persons as having unescorted access to a secure area of the airport.
  8. Critical aviation asset information identifying systems so vital to the airport that the incapacity or destruction of such assets would have a debilitating impact on

- aviation security.
9. Any information involving the security of operational or administrative data systems identified by the Department of Transportation or DHS as critical to the safety or security of Denver International Airport.
  10. Solicited or unsolicited proposals, pursuant to a grant or contract, to perform work that relates to security measures.
- G. Restrictions on the Disclosure of SSI:
1. Employees and contractors working onsite have a duty to protect sensitive security information and must take reasonable steps to safeguard SSI in that person's possession from unauthorized disclosure. When a person is not in physical possession of SSI, the person must store it in a secure container such as a locked desk, a locked file cabinet, or in a locked room. SSI is to be disclosed only to persons having a need to know as stated in CFR 1520. Requests for SSI are to be referred to City Project Manager.
  2. Prior to receiving SSI records, contractors must sign the "Confidentiality and Non-Disclosure Agreement", Form PS-17, stating that SSI will be guarded from unauthorized persons, that records will be controlled while in use and secured when not in use, and that all SSI plans and records will be returned to the airport or destroyed following the completion of the Project.
  3. Return or destruction of SSI documents must be done in a timely manner and documented on the SSI Return or Destruction Compliance Form, Form PS-20. Companies under contract to the City must return or destroy all SSI material following the completion of the Work. Companies not selected during the bidding process must return or destroy all SSI material immediately following the announcement of bid results.
- H. If a record containing SSI is received that is not marked as specified in this Section below, the following steps must be taken:
1. Mark the record as specified in paragraph Part 1 of this Section.
  2. Inform the sender of the record that the record must be marked as specified in Part 1 of this Section.
- I. If a person becomes aware that SSI has been released to unauthorized persons, promptly inform the Communication Center Supervisor at 303-342-4020 and request to speak to the on-call Airport Security Coordinator
- J. Marking SSI:
1. In the case of paper records containing SSI, a covered person must mark the record by placing the PROTECTIVE MARKING conspicuously on the top, and the DISTRIBUTION LIMITATION STATEMENT on the bottom, of following parts of the document:
    - a. The outside of any front and back cover, including a binder cover or folder, if the document has a front and back cover.
    - b. Any title page
    - c. Each page of the document

2. Protective Marking:
  - a. SENSITIVE SECURITY INFORMATION
  - b. Distribution Limitation Statement:
  - c. WARNING: This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a "need to know", as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520
3. In the case of non-paper records that contain SSI, including motion picture films, videotape recordings, audio recording, and electronic and magnetic records, a covered person must clearly and conspicuously mark the records with the protective marking and the distribution limitation statement such that the viewer or listener is reasonably likely to see or hear them when obtaining access to the contents of the record.

K. Destruction of SSI:

1. When the employee or contractor no longer needs the SSI to carry out their work requirements, the SSI must be returned to the issuing entity or completely destroyed by burning or cross-shredding to preclude recognition or reconstruction of the information.
2. The Contractor shall comply with all the requirements of the Department of Aviation Standards and Procedures, Protection of Sensitive Security Information (SSI) No. 10003 Revised 08/01/15 regarding Contractor Protection of Sensitive Security Information (SSI).

1.5 MISCELLANEOUS

A. Dumpster Security Requirements:

1. The following procedures must be followed to provide maximum security with all construction projects in public areas unless an exception has been made by the Airport Security Coordinator (ASC) or designee:
  - a. Roll-off dumpsters must have the ability to be covered (hard side) and locked when not in use.
  - b. When unlocked and in use, the Contractor shall provide an employee, or a subcontractor's employee, to stand by the dumpster to prevent unauthorized placement of prohibited items
2. If the Contractor is not able to have a roll-off dumpster with the ability to be locked, the dumpster shall be removed from the public area when the construction site is inactive.

**B. Contractor Fences (Not Perimeter Fence):**

1. If required, the Contractor shall establish and maintain a secure (fenced) perimeter at its primary operations area to include its field offices, staging and storage areas, and maintenance facilities. The responsibility for security within its operations area shall rest solely with the Contractor. Entrance gates to operations areas shall be equipped with a combination of locks to include a lock provided by the City for its use in accessing emergency equipment, should that need arise. The location, size and other physical characteristics of the Contractor's operations area must be approved by the DEN Project Manager prior to its installation.
2. Unless specifically required by the Contract Documents and with the exception of the fenced operations area described above, the Contractor shall install no fences or other physical obstructions on or around the Project work area without the written approval of the DEN Project Manager.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 SUBMITTAL FOR AIRPORT ID BADGES**

- A. By submitting information for the individual requesting or requiring an Airport ID badge that would permit unescorted access to the Sterile and/or Secured Areas must be fingerprinted and pass a Criminal History Records Check (CHRC) and Security Threat Assessment (STA). Passing a CHRC means the employee shall not have been convicted, given a deferred sentence, found not guilty by reason of insanity or have been arrested and are awaiting judicial proceedings of any felony charge during the ten (10) years before the date of the individual's application for unescorted access authority. For an individual to obtain driver authorization to drive within the Secured Area, the individual must have a valid driver license that allows them to drive their contractor vehicle.
- B. An employee requesting an Airport ID badge must resolve all pending or valid violations before being allowed to proceed in the airport ID badging process. If the employee no longer works for the company and is attempting to be employed by a different company, a management representative from the "new" company must attend the Violation Notice Hearing along with the employee.
- C. Airport ID Badges are obtained as follows:
  1. The Contractor shall meet with the City Project Manager to review the procedures and required access points at DEN. The Contractor and the DEN Project Manager shall visit the site to verify the access points. Access points shall be listed and submitted by the Contractor to the DEN Project Manager for review and comment prior to Contractor's application for badging.
  2. The Contractor shall designate an Authorized Signatory who must attend an

- annual class with Airport Security. The Authorized Signatory must be an employee of the Contractor, have a valid Denver International Airport ID badge. The Authorized Signatory will be authorized to sign for the Contractor on the Fingerprinting and Badge Application Form and will be the primary designation contact for Airport Security related business.
3. The Contractor's Authorized Signatory shall schedule a Participant Meeting with the DEN Airport Security Office to review DEN security procedures and receive training on how to ensure that all Participants remain in compliance with Part 20 of the Denver Municipal Airport System Rules and Regulations. A second meeting will be scheduled for the Authorized Signatory to learn how to successfully complete the required forms for Airport ID badges and vehicle permits.
  4. A CHRC and STA are required for each employee requesting unescorted access to the Secure and/or Sterile Area. The employee will complete the Fingerprinting and Badge Application (two-sided form) and schedule an appointment with the Airport Security Office to have the form reviewed and to be fingerprinted. The Federal Bureau of Investigation will conduct the CHRC and will return the results to the Airport Security Office. For the fee for the Fingerprinting, please see the flydenver.com website. The Transportation Security Administration will process the STA and will return the results to the Airport Security Office.
  5. When the Authorized Signatory is notified by Airport Security that the CHRC and STA have cleared, the applicants must come to the Airport Security Office to receive regulated security and driver training. The training will take approximately one (1) hour for security training and approximately two (2) hours for security and driver training.
  6. All applicants must watch and pass all concepts of a computer based security training module for a Security Identification Display Area (SIDA) Airport ID badge. All individuals requesting driver authorization in the non-movement area must also view an interactive computer based driver training module and complete a test by passing all concepts. In addition, the individual must receive non-movement driver orientation training by the Contractor's driver representative before being allowed to drive on the airfield. Non Movement Orientation training should be conducted annually.
  7. All Airport ID badges must be immediately terminated upon employee separation from the Contractor or when a need for DEN access no longer exists.
  8. The Airport ID badges must be returned to the Airport Security Office prior to final payment. All Airport ID badges are issued with an annual expiration date. The expiration date is determined by the birthday of the Airport ID badge holder. Contractors shall notify the DEN Project Manager as soon as possible but in no case less than four (4) weeks in advance of any requirement to extend the Sponsorship status.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

**END OF SECTION 011420**

## SECTION 011430 - VEHICLE AND EQUIPMENT PERMITTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Contractor shall comply with the Airport Security Program. Vehicle permits are required for all vehicles operating in the Secured Area. The DEN vehicle permit is required for vehicles operating in the Secured Area but limited to above grade, outdoor activity. Vehicles or machinery operating within buildings shall be required to acquire a DEN emissions permit as well as a DEN vehicle permit.
- B. Special emphasis should be paid to Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program". The Denver Municipal Airport System Rules and Regulations can be found on the flydenver.com website.
  - 1. All Work shall be accomplished in accordance with the most current FAA Advisory Circular (AC) 150/5370-2, "Operational Safety on Airports during Construction", 49 Code of Federal Regulations (CFR) Part 1542 and 14 CFR Part 139 except as modified herein.
  - 2. All Work shall be accomplished in accordance with the most current TSA Security Directives applicable to DEN, except as modified herein.
  - 3. Access to the runways, taxiways, and aprons shall be gained by the Contractor after establishing radio communications with Airport Operations through the DEN Inspector. No personnel or equipment will be allowed on the runways until radio contact has been made with Airport Operations and permission given.
  - 4. Access to the Movement Area will be limited in order to allow the maximum efficient movement of aircraft. As part of this limitation, the Contractor may be required to only use these areas late at night when there is less aircraft traffic
  - 5. Once admitted into the Secured Area, the Contractor shall proceed directly to the work location by way of a route assigned by Airport Security. At no time shall a Contractor or any of its personnel enter onto a taxiway, runway, or ramp without proper clearance from the Airport Operations Manager or Assistant Airport Operations Manager. Contractors or individuals violating these requirements for driving in the Secured Area may be subject to fines, suspension, or permanent revocation of their driver authorization and/or Airport ID badge privileges.
  - 6. The Transportation Security Administration (TSA) requires that all operating airports be secured from the general public and has the authority to issue citations for violations of these requirements. It is the responsibility of the Airport

to ensure all fences and gates are secure. If a Contractor's operations necessitate the frequent use of a particular gate, the Contractor shall place guards at the gate. Refer to 011420 – Security Requirements and SSI for details regarding the placement of guards.

C. General Safety Regulations When in Aircraft Operations Areas May Include the Following:

1. At all times, the Contractor shall coordinate its Work with the requirements of the Airport site and operations. All Work, movement of personnel, materials, supplies and equipment in areas used by aircraft shall be subject to regulations and restrictions established by the City. The Contractor shall take special precautions and be fully responsible for the prevention of damage to materials and equipment in the areas affected by the jet blast of taxiing aircraft. No work shall proceed until necessary protective devices are placed as required to protect the public, airport operations, property, and personnel from the hazards of the Work. The Contractor shall proceed with the Contractor's Work, including temporary work and storage of tools, machinery, and materials, to cause no interference with or hazards to the operation of the Airport.
2. Landings, takeoffs, and taxiing shall take precedence over all Contractors' operations. In the event that the Contractor is notified that an emergency landing or a takeoff is imminent, the Contractor shall stop all operations immediately, regardless of the sequence of events in progress and shall immediately evacuate the Contractor's personnel and equipment from the runway and taxiway areas as directed.
3. The Contractor shall remove its personnel and equipment to the distance specified below for the prevailing conditions:
  - a. For emergencies, the Contractor shall move all personnel and equipment as directed by Airport Operations or the DEN Project Manager.
  - b. At the end of a work day in areas where aircraft are operating, all equipment shall be moved to a location that is not less than 750 lineal feet measured from the near edge of the runway, taxiway or ramp area or to the location designated by the City.
4. If the Contractor is asked to leave part of its work site to allow aircraft operation, the Contractor shall clean the area to allow safe aircraft movement. Cleaning may include sweeping the area to prevent damage to aircraft.

D. Vehicle Permitting:

1. Refer to the Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program" for information regarding vehicle permitting. These Denver Municipal Airport System Rules and Regulations can be found on the flydenver.com website.
2. For additional information regarding permitting, the Contractor must contact DEN Security.

E. Equipment Permitting



1. Fossil fuel powered equipment to be used in the interior of buildings and/or in basement/tunnel areas shall require inspection by DEN Maintenance and the Denver Fire Department.
  - a. Only CNG fossil fuel powered equipment may be used; gasoline powered, propane powered, or diesel powered equipment will not be acceptable unless identified and operated per Section 011400 "Work Sequence and Constraints".

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 PERMITS**

- A. Vehicle permits shall not be issued prior to Notice to Proceed. The Contractor may, at the Contractor's own risk, submit required information prior to Notice to Proceed to the following:
  1. Vehicle permit: DEN Engineering Group or DEN Airport Security.
  2. Equipment and vehicle emissions permit. DEN Engineering or DEN Maintenance Group.

### **3.2 SCHEDULE**

- A. The Contractor shall allow in the Contractor's schedule five (5) days for DEN review of submittals for permits. Testing of equipment and review by the Denver Fire Department shall be scheduled by the Contractor. By submitting information for permits, the Contractor certifies that equipment and vehicles comply with Contract documents and with all City, state and federal regulations including but not limited to emissions, licensing and safety requirements.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

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

END OF SECTION **011430**

## SECTION 011810 - UTILITIES INTERFACE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Various utilities are located within the limits of work in the Project area. The owners of these utilities hereinafter noted may require that the Contractor is to work around their existing facilities until such alterations, relocation, or abandonment have been completed. All known existing utilities are shown; however, the Contractor shall verify and satisfy himself that there are no other existing utilities that may not be shown.
- B. The owners of known utilities within the project area and corresponding representatives include, but are not limited to:
  - 1. Century Link Telephone
  - 2. DEN Telephone
  - 3. Xcel Energy Natural Gas
  - 4. Xcel Energy Elec. Services
  - 5. DEN Storm Water
  - 6. DEN Sanitary Sewer
  - 7. Denver Water Department
  - 8. Inland Technologies
  - 9. Fuel System (ASI)
  - 10. Premise Wiring System- DEN IT Section
  - 11. FAA Duct Bank
  - 12. Oil/Gas Wells
  - 13. DEN Electrical Department
  - 14. Fire Alarm System
  - 15. Paging System
- C. The location and establishment of each construction vehicle crossing shall be at sites mutually agreed upon in writing by the Contractor and the owner of the utility.
- D. At the locations where the Contractor needs to establish a construction vehicle crossing over any of the operating pipelines, the furnishing and placing of a crossing shall be by the Contractor. The crossing shall allow the normal operation of the pipeline at all times. Each crossing shall be adequately marked and signed for safe passage of vehicles over the crossing. Construction vehicles shall not be allowed to cross over operating pipelines at any place other than an established crossing.
- E. These utility locations are based upon information provided by the utility companies or

previous construction contractors that were the basis for determining utility coordinates. The Contractor is responsible for confirming the accuracy of the provided coordinates.

- F. The Contractor shall control the Contractor's operations in order to avoid creating any obstacles for the utility owner's access for maintaining or operating their equipment.

### 1.3 REFERENCE DOCUMENTS

- A. Section 312323.33 "Flowable Backfill (Controlled Low-Strength Material)"

### 1.4 REGULATORY REQUIREMENTS

- A. The Contractor shall obtain and pay for all utility company permits, fees, and licenses necessary for the execution of this work. The Contractor shall give all notices and shall comply with all laws, ordinances, rules, and regulations of all authorities having jurisdiction.

### 1.5 QUALITY CONTROL

- A. When the Contractor performs any operations that will affect a utility owner, the Contractor shall give timely notice to the utility owner and the DEN Project Manager so that the Contractor's operations may be observed by the utility owner or their representative.

### 1.6 WORK INCLUDED

- A. The Work of this Section includes furnishing all materials, equipment, and labor necessary to provide utility crossings as required and as specified herein and subject to approval by the associated utility owner.
- B. North American Resources has a line passing through airport property. The Contractor shall contact the utility prior to beginning earthwork operations to ascertain any special requirements or conditions required to maintain and protect this service during construction activities.
- C. FAA Underground Duct lines: The FAA has duct lines passing under the site. The Contractor shall contact the FAA prior to beginning earthwork operations to ascertain any special requirements or conditions required to maintain this service during construction activities.

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## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Suitable cover material shall be in accordance with Colorado Department of Transportation Standard Specifications. Wet, soft, or frozen material, asphalt chunks, or other deleterious substances shall not be used for cover.
- B. Aggregate for road base material shall consist of clean, sound and durable particles of crushed stone, crushed gravel or crushed slag, shall be free from coatings of clay, silt and organic matter, and shall contain no clay balls. Material shall conform to the State of Colorado Standard Specifications for Road and Bridge Construction Class 6 aggregate base unless otherwise specified.
- C. The materials for the load distribution system on top of the cover shall conform to the specification of the American Institute of Steel Construction, the American Institute of Timber Construction, or the American Concrete Institute, as applicable, depending upon the system agreed upon between the Contractor and utility owner.
- D. Materials for the sleeving of the pipelines shall be purchased by the utility owner at the Contractor's expense.
- E. Comply with utility backfill requirements for the use of flowable backfill in Section 312323.33 "Flowable Backfill (Controlled Low-Strength Material)" and Division 26 and Division 33 requirements.

## **PART 3 - EXECUTION**

### **3.1 NOTIFICATION OF UTILITIES FOR LOCATING AND POTHOLING**

- A. The Contractor shall verify the location of all utilities prior to any operations including physically uncovering the utility to verify location as required by the utility owner.
- B. The Contractor shall notify the Utility Notification Center of Colorado at (303) 534-6700 or 811, as a minimum for location of utilities.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **011810**

## SECTION 012910 - SCHEDULE OF VALUES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 RELATED REQUIREMENTS

- A. The Work specified in this Section consists of preparing and submitting the Schedule of Values ("Schedule") as referenced in the General Conditions. Use the Project Specifications Table of Contents or Bid Tabs, if applicable, as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. The Work also includes the preparing and submitting of updated copies of the Schedule if the Schedule is affected by change orders.
- B. A Schedule of Stored Material is a detailed cost breakdown for permanent materials that will be temporarily stored prior to their being installed and for which the Contractor seeks partial payments. The Schedule of Stored Material will be incorporated as a part of the Schedule of Values.
- C. Within 14 calendar days of issuance of the Notice to Proceed (NTP), the Contractor shall submit the Schedule of Values including the Schedule of Stored Material if applicable. The Schedule of Values and Schedule of Stored Material used to prepare the work/cost breakdown for the Schedule will be used for the Contractor's billings.
- D. Any Contract allowances shall be included in the Schedule. Expenditure of allowances shall be done using the Allowance Authorization form. Use of this form does not increase or decrease the Contract value.

#### 1.3 RELATED DOCUMENTS

- A. Title 9 – Compensation of the General Contract Conditions, 2011 Edition
- B. Section 013300 "Submittal Procedures"
- C. Section 013325 "Shop and Working Drawings, Product Data and Samples".
- D. Form CM-89, Schedule of Values
- E. Form CM-91, Schedule of Values for Unit Price Contracts

#### 1.4 SUBMITTALS

- A. The Schedule of Values shall be formally approved by the DEN Project Manager.
- B. The Schedule shall identify each item of work. Work items in the Schedule shall represent all Work and shall be referenced with the Technical Specifications section numbers, specification subparagraph, specification section title and the bid item number used for the Schedule of Prices and Quantities when applicable.
- C. Upon request by the City, the Contractor shall support values given with the data that will substantiate the correctness of the values.
- D. The Schedule will be utilized only as a basis for review of the Contractor's application for progress payment.

#### 1.5 REVIEW AND RESUBMITTAL

- A. If review by the DEN Project Manager indicates that changes to the Schedule are required, the Contractor shall revise and resubmit the Schedule.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### 3.1 PREPARING SCHEDULE OF VALUES

- A. Provide a breakdown of the Contract Price in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
- B. Breakdown of the items used in the Schedule shall include the following item costs. Ensure each item is complete:
  - 1. Delivered cost of product with applicable taxes paid.
  - 2. Total installation cost with overhead and profit.
  - 3. Breakdown costs of each lump sum item with a list of products and major operations for which the Contractor seeks to receive progress payments to recover the Contractor's costs for that bid Item.
  - 4. Each unit price item as listed in the bid Schedule of Prices and Quantities shall list products and major operations for which the Contractor seeks to receive progress payments for that bid item.

#### 3.2 PREPARING SCHEDULE OF STORED MATERIAL

- A. The Contractor shall submit with the Schedule an indication of whether products will be stored on or off the work site. The Schedule of Stored Material shall show all quantities and types of products that will be stored.



- B. Material allowances consist of only the net cost of the product, the cost of delivery and unloading at the storage site, the cost of applicable sales taxes, and all discounts.
- C. In no case will the cost paid for a permanent material be greater than 90 percent of the Contract price for the Work in which they are included.

### 3.3 PAYMENT FOR STORED MATERIALS

- A. Only materials that are described in the specifications and on the drawings will be considered permanent materials. Permanent materials are materials that will be left in the Work after the Contract is completed.
- B. Nothing in these specifications shall be interpreted as requiring the City to pay for stored materials. The DEN Project Manager shall decide on a case-by-case basis whether stored materials shall be paid for. No payment will be made for stored materials that have not been submitted and accepted.
- C. The Contractor must, at all times, store permanent materials in accordance with manufacturer's recommendations. Any material not properly stored will not be paid for. Amounts will be deducted from payments for any stored permanent material previously paid for and subsequently found to be improperly stored or not present, based upon a physical inventory of stored permanent material.
- D. Only the neat line quantity of material needed for the finished product may be paid for.
- E. All requests for stored permanent material payment must be accompanied by paid invoices clearly showing the quantity of permanent material, the type of permanent material and discounts or rebates and the net amount paid to the supplier along with a certificate stating that the permanent material is free of any liens or judgments preventing its use by the City.
- F. If the permanent material is stored outside the Denver area the Contractor must pay for the City representative's transportation and lodging to see the stored material as needed. Acceptable lodgings must, as a minimum, have a Mobil Travel Guide Rating Criteria® rating of Two-Star or the American Automobile Association Lodging Listing Requirements & Diamond Rating Guidelines® rating of Two Diamonds. The minimum transportation shall be by regularly scheduled commercial air carrier at coach rates. The DEN Project Manager will determine if an overnight stay is required.
- G. All permanent material stored off site, for which payment is being requested, must be insured and stored in bonded, insured warehouses. The Contractor shall provide proof of insurance for all material stored off site, and specific address and storage conditions of storage location.
- H. Any permanent material on which payment is requested must be in such a form that it cannot be used on work other than this Contract, or stored in a manner acceptable to the DEN Project Manager to ensure that the permanent material cannot be used on work other than this Contract.

3.4 ALLOWANCE AUTHORIZATION AND PAYMENT

- A. Contractor shall request written approval for expenditure of any Contract allowances PRIOR TO performing the Work involved. List work to be performed and estimated cost in the requesting correspondence.
- B. Original copies of all invoices and receipts must be submitted with the Allowance Authorization as part of the request for payment.
- C. Using the format provided by the City, the Contractor's request for payment of all Contract allowances shall be included in the Schedule of Values.

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **012910**

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations and coordination with other stakeholders and adjacent Contractors on the Project including,

1. Subcontractor's Acceptance Certification and Subcontractors List.
2. General Coordination Procedures.
3. Contract Administration Procedures.
4. Current Project Management Information Systems (PMIS)
5. Coordination drawings.
6. Current DEN Asset Management Systems
7. Requests for Information (RFIs).

- B. Related Requirements:

1. Section 011100, " Summary of Work" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Section 011400 "Work Sequence and Constraints" for shutdown requests and coordinating with airport operational activities.
3. Section 011420 "Security Requirements and Sensitive Security Information (SSI)".
4. Section 013210 "Schedule" for preparing and submitting Contractor's Construction Schedule.
5. Section 013223 "Construction Layout, As-built and Quantity Surveys" for coordinating, survey activities and survey related record documents.
6. Section 013300 "Submittal Procedures. "
7. Section 013325 "Shop and Working Drawings, Product Data and Samples".
8. Section 017720 "Contract Closeout" for coordinating closeout of the Contract.
9. Section 017419 "Construction Waste Management and Recycling".
10. DEN Building Information Modeling (BIM) Design Standards Manual (DSM)

#### 1.3 DEFINITIONS

- A. RFI: Request from the DEN Contractor DEN Project Manager seeking information required by or clarifications of the Contract Documents.

1.4 SUBMITTALS - SUBCONTRACTORS ACCEPTANCE CERTIFICATION AND SUBCONTRACTORS LIST

- A. To comply with Section 502.2 in the General Contract Conditions, 2011 Edition, the Contractor must complete and submit form CM-02 Subcontractor Acceptance Certification for each Subcontractor working on the project. Additionally, the Contractor must prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
- B. Provide emergency contacts list to the DEN Project Manager prior to any site activities. List must contain project name, number, location, company name and address, name and title of emergency contacts in order and time and assigned responsibilities. Keep list current and accurate at all times. Include any specific security arrangements or special projects requirements.
- C. Within two (2) days of Notice to Proceed, the Contractor shall submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identifying individuals and their duties and responsibilities listing addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Providing names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of the accepted list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination with other Contractors:
  - 1. For details on coordinating with other Contractors, refer to Article 701 Cooperation with Other Work Forces, Article 702 Coordination of the Work, and Article 703 Coordination of Public Contact in the General Contract Conditions, 2011 Edition.
- B. Minimum cooperation requirements with other contractors include the following, unless directed by the DEN Project Manager in writing:
  - 1. Regular meetings, minimum weekly.
  - 2. Construction schedule coordination.
  - 3. Staging area and access planning (to include employee shuttle routes).
  - 4. Deliveries.
  - 5. Traffic control.
  - 6. When and where required or specified, the Contractor shall develop appropriate coordination drawings for use by interfacing adjacent parties using the Denver International Airport site.
- C. The following is a list that includes, but is not limited to, all of the contractors that will be working in the area of the project limits:

- D. Coordination with DEN entities shall include but is not limited to the following:
1. Coordinate with Owner Contracted Communication Contractor.
  2. Coordinate with Utility Companies for utilities that are single sole source.
  3. Coordinate with Airport Security and DEN Maintenance for all security related services.
  4. Coordinate with DEN Life Safety Team for all issues related to fire alarm, fire protection systems in addition to compliance with all regulatory agencies.
  5. Coordinate all shutdowns and system interruptions in accordance with section 011400 "Work Sequence and Constraints."

1.6 Contract Administration Procedures:

- A. This Project will be administered in part using the current Project Management Information System (PMIS). Any processes necessary to properly administer the Contract and not included in the list below shall be addressed as acceptable to the DEN Project Manager. DEN Project Manager may modify the list below in serialized correspondence without constituting a change to the Contract. Administrative tools and processes shall not in any form waive any contractual or legal requirements of the law or the Contract. The Contractor shall attend all coordination meetings with the DEN Project Manager and the DEN Project Control Administrators to arrange for staff training, and technical support to facilitate the execution of electronic data management and control.
- B. Project Management Information Systems (PMIS): Oracle Unifier Enterprise Project Portfolio Manager (EPPM), or the Oracle Primavera P6.
- C. All submittals, RFIs, Pay Applications, Correspondence, change requests, and pricing proposals and settlement agreements shall be recorded and submitted using the current PMIS:
1. The Contractor shall follow the specified PMIS Access Request Procedure and adhere to all user license conditions.
  2. The Contractor shall sign the Information Technology Agreement (ITA) to comply with the DEN computer system security requirements and any contractual obligation to the software and service providers for the current PMIS software
  3. DEN will train the Contractor's staff on the use of the PMIS.
  4. At a minimum, the Contractor shall provide computer hardware and software to meet the following requirements and to run the following programs, as required for the project:
    - a. Internet connectivity that provides the necessary high-speed connection to perform all activities indicated in this Contract.
    - b. Internet Explorer version 8 or higher.
    - c. Based on the project, a specific Java JRE application may be required, which can be downloaded from the Internet. If needed, the revision and update number will be provided at NTP.
    - d. Other files capability pre-approved by the DEN Project Manager or as required by the DEN BIM Execution Plan

- e. Most current version of Revit, as per DEN requirements.

## 1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, BIM Design Standards Manual and BIM Project Execution Plan (BPXP), and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity. Coordination drawings will be the result of a Contractor driven Spatial Coordination effort as spelled out in the BPXP.
  1. Field verify all existing dimensions and any as-built dimensions, whether built by the Contractor or others, necessary to produce accurate coordination and working drawings.
  2. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Models/Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Models/Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to DEN Project Manager indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Using software as in the BPXP, the Contractor shall coordinate these systems per floor or zone per BPXP, and as follows:
  1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems,

- mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  7. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor control center locations.
    - d. Location of pull boxes and junction boxes dimensioned from column centerlines.
  8. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  9. Review: DEN Project Manager will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If DEN Project Manager determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, DEN Project Manager will so inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings, unless approved otherwise by DEN Project Manager.
  2. File Preparation Format: Provided in the Project BIM Execution Plan operating in Microsoft Windows operating system.

3. File Submittal Format: Submit or post coordination drawing files as required in the Project BIM Execution Plan.
  4. The submittal must be logged in accordance with the submittal procedure
  5. For Fire Protection system; provide shop drawing and design calculations as approved by the building department. Submit as-built drawings in format as outline in BXP.
  6. For all projects, receiving official variance from the BIM requirements not utilizing BIM, coordination drawings must be submitted in acceptable digital format shall be in an industry recognized 3D AutoCAD model.
  7. BIM File Incorporation: DEN Project Manager will incorporate Contractor's coordination drawing files into Building Information Model for Revit as established for Project.
    - a. Contractor shall lead three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect or other sub-consultants.
  8. DEN Project Manager will furnish Contractor one (1) set of digital data files of Models and/or Drawings for use in preparing coordination digital data files.
    - a. The Design consultants and Contractors and Sub Contractors acknowledge and represent the following Right Of Reliance regarding Electronic Models and/or Drawing deliverables:
      - 1) Models may be transferred for allowing the recipients to develop derivative models to develop the means and methods by which to construct the project.
      - 2) It must be clear that each party be able to rely on the fact that the model furnished by others "match the 2D Contract Documents or shop drawings in their equivalent state of development"
- 1.8 Coordination with DEN Asset Management System:
- A. The full intent is to produce comprehensive record documents integrating existing data in the form of digital files and models, reconciled to actual field conditions, modifications or additions facilities or components of existing facilities according to new Contract Documents, and to produce record documents that could be incorporated into DEN asset management system.
  - B. Utilize the BIM to link all necessary data content to the model and follow the BXP as collaboratively modified by the Contractor, Designer, and DEN BIM Administrators and approved by DEN Project Manager
  - C. Provide the following information through the execution of the Contract for all elements and element types that DEN has designated as assets. The information shall include but is not limited to:
    1. Project title, number, project manager contact information, contractor and



- subcontractor contact information
- 2. Pertaining shop drawings
- 3. Operational Manuals and safety information, MSDS and cut sheets, and any pertinent technical information.
- 4. Details of all components' maintenance procedures and requirements.
- 5. Details of all applicable warranties including but not limited to; warranty providers, manufacturers information, warranty start and finish dates, contacts , bonding company name, consent of surety,
- 6. Equipment location (by room number and location description or grid location format acceptable to DEN Project Manager, for civil projects), equipment make, model, serial number, and other asset information as outlined in the DEN BIM DSM
- 7. List of all spare parts including but not limited to; equipment make and model, location, submittal number or link, and suppliers reordering information
- 8. Commissioning results, acceptance criteria, test reports, and Tab reports

#### 1.9 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI through the PMIS
  - 1. DEN Project Manager will distribute the RFIs to the proper entities.
  - 2. DEN Project Manager will coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's Work or work of subcontractors
- B. DEN Project Manager has the right to reject-RFIs or those that do not contain proper information and required data to properly evaluate the request and respond in a timely manner.
- C. RFIs: Use PMIS to generate RFIs.
  - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
  - 2. Attachments include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- D. For projects not using Unifier to create the RFI, the RFI must include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.
  - 4. Name of Contractor.
  - 5. Name of DOR[ **and DEN Project Manager**].
  - 6. RFI number, numbered sequentially.

7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- E. DEN Project Manager will review each RFI, determine action required, and respond. RFIs received by DEN Project Manager after 1:00 p.m. will be considered as received the following working day. Direct responses by any entity other than DEN Project Manager shall not be binding to the City and County of Denver. E-mails, and verbal conversations must be followed by an official RFI or proper contractual vehicle before it is considered for any additional compensation or time impact to the project terms and conditions.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of DEN Project Manager's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. DEN Project Manager's action may include a request for additional information, in which case DEN Project Manager's time for response will date from time of receipt of additional information.
  3. DEN Project Manager's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Title 11 - Changes In the Work, Contract Price, or Contract Time in the General Contract Conditions, 2011 Edition as amended by Special Conditions.
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify DEN Project Manager in writing within five (5) days of receipt of the RFI response or the time required by Title 11 - Changes In the Work, Contract Price, or Contract Time in the General Contract Conditions, 2011 Edition
- F. RFI Log: For projects not utilizing the PMIS application, prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. The log shall include but not limited to the following data:
1. Project name.

2. Name and address of Contractor.
3. Name and address of DEN Project Manager.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date DEN Project Manager's response was received.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT:

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT:

- A. No additional Payment will be made for compliance with the requirements of this section.

**END OF SECTION 013100**

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## **SECTION 013119 - PROJECT MEETINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. The Work specified in this Section requires the Contractor's Project Manager, Superintendent, and Quality Control representative to attend meetings scheduled by the DEN Project Manager for the collection and dissemination of information related to the subject Contract.
- B. The DEN Project Manager will prepare the minutes of each meeting and distribute them to each of the participants.

#### **1.3 REFERENCE DOCUMENTS**

- A. Form CM-01, Preconstruction Meeting Agenda
- B. Form CM-62, Construction Meeting Agenda/Minutes

#### **1.4 OTHER MEETINGS**

- A. The Contractor shall attend all other project related meetings as directed by the DEN Project Manager.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 PRECONSTRUCTION MEETING**

- A. A Preconstruction Partnering Process will be scheduled by the DEN Project Manager after the Contract has been signed by all parties. The purpose of this meeting is to introduce the City's Representatives to their counterparts in the Contractor's organization and to establish lines of communication between these representatives and outline some Contract requirements. The Contractor's key personnel shall attend this meeting.

- B. The DEN Project Manager will distribute a notice of these meetings, along with an agenda of the subjects to be addressed. Refer to form CM-01, Preconstruction Meeting Agenda.
- C. The DEN Project Manager will explain and discuss the responsibilities and authorities of the City, the Designer of Record, and the DEN Project Manager's organization.
- D. The Contractor shall introduce the Contractor's key personnel, subcontractors, and representatives and briefly describe each person's responsibilities.
- E. Explanations provided by the DEN Project Manager will not amend, supersede, or alter the terms or meaning of any Contract document, and the Contractor shall not claim reliance on such explanations as a defense to any breach or failure by the Contractor to perform as specified in the Contract.

### 3.2 CONSTRUCTION PROGRESS MEETINGS

- A. Progress meetings will be scheduled weekly and more often as necessary by the DEN Project Manager to promote the competent and timely execution of the Contract.
- B. The meetings will be held at the work site or at a location selected by the DEN Project Manager. Meetings will be chaired by the DEN Project Manager or the DEN Project Manager's representative.
- C. The Contractor's key personnel shall attend unless otherwise agreed by the DEN Project Manager.
- D. At a minimum, and as directed by the DEN Project Manager, the items detailed in CM-62, Construction Meeting Agenda/Minutes shall be addressed at each meeting. The items addressed in the meeting do not waive notification or submittal requirements as required elsewhere in the Contract.
- E. The DEN Project Manager will be responsible for publishing minutes of the meetings. Refer to form CM-62, Construction Agenda/Meeting Minutes.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

- B. All payments for any Work done under this contract shall be in accordance with Title 9  
- Compensation of the General Contract Conditions, 2011 Edition.

END OF SECTION **013119**

## SECTION 013210 - SCHEDULE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section describes the procedures and requirements for scheduling and documenting the progress of the project.

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Contractor's Monthly Construction Schedule update.
4. As-built Schedule.
5. Three-Week Look-Ahead Schedule.
6. Daily Construction Reports.
7. Submittal Schedule.
8. Fabrication Schedule.
9. Material Delivery Schedules, cranes, special equipment and staging status.
10. Special reports:
  - a. Weather impacts and mitigations.
  - b. Recovery Schedule and alternatives.

- B. Reference Documents

1. Article 1105 – Time Extensions in the General Contract Conditions, 2011 Edition.
2. Section 011100 "Summary of Work"
3. Section 011420 "Work Sequence and Constraints".
4. Section 012910 "Schedule of Values".
5. Section 013119 "Project Meetings"
6. Section 013300 "Submittal Procedures"

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a Construction Schedule consume time and resources:
  1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  2. Predecessor Activity: An activity that precedes another activity in the network.

3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation given in the Schedule of Values for the completion of an activity as scheduled. The sum of costs loaded for all scheduled activities must equal the total Contract Value unless otherwise approved by DEN Project Manager. All project costs, including those for stored materials and allowances, shall be loaded into the schedule and shall be balanced to where no activity is unfunded.
- C. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based upon defined relationships. Defined relationships determine when activities can be performed and the critical path for completing the Work.
- D. Critical Path: The longest chain of interdependent activities through the network sequence that establishes the shortest duration for completing the work and contains no float. The critical path shall be calculated as total float equal to but not less than zero days.
- E. Float: The amount of time that an activity in a network sequence can be delayed without causing a delay to subsequent activities and/or the completion date of the Work:
1. Float is not for the exclusive use or benefit of either the City or the Contractor but is jointly owned. Liability for delay to the Substantial Completion of the Work rests with the party whose actions, last in time, actually cause a delay to the Substantial Completion date.
  2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of its successor activity.
  3. Total float is the amount of time that an activity may be delayed from early start without adversely affecting the Substantial Completion date.
- F. Resource Loading: The allocation of direct man-hours by trade, material, equipment, subcontractors, and all other resources required to complete each activity. The contractor shall account for the indirect man-hours in the cost. The indirect labor hours could be tracked and reported separately, if agreed upon between the Contractor and the DEN Project Manager prior to the start of the Work.
- G. Direct Man-hours: Man-hours related only to the physical construction of the Work, i.e., masonry, mechanical, electrical, drywall, carpeting, etc.
- H. Indirect Man-hours: Man-hours related to support of the physical construction of the Work, i.e., cleanup, mobilization, traffic control, temporary activities, badging, supervision and overhead, etc.
- I. Work Breakdown Structure (WBS): A hierarchical arrangement of the activities that allows for the roll-up and summarization to a predetermined level. The level of breakdown shall be agreed upon by the Contractor and the DEN Project Manager prior to the start of Work.



## 1.4 SUBMITTALS

### A. Scheduler Qualifications

1. Scheduling Consultant Qualifications: A professional specialist, experienced in CPM scheduling and reporting with capability of producing CPM reports and diagrams who can quickly produce these reports/diagrams within 24 hours of the DEN Project Manager's request. Review methods and procedures related to the set-up in the PMIS of Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - a. Review content and format for reports.
  - b. Verify availability of qualified personnel needed to develop and update schedule.
  - c. Discuss constraints, including phasing, area separations, interim milestones, and partial Owner occupancy.
  - d. Review delivery dates for Owner-furnished products.
  - e. Review submittal requirements and procedures.
  - f. Review time required for review of submittals and resubmittals.
  - g. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - h. Review time required for Project closeout and Owner start-up procedures, including commissioning activities.
  - i. Review procedures for updating schedule.
  - j. Review requirements for content and input of direct man-hour resources in activities.
  - k. Review requirements for cost loading of activities.

### B. Format for Submittals: All schedules shall be submitted in the following format:

1. The Contractor shall develop Critical Path Method (CPM) Schedule utilizing the applicable PMIS. The schedule shall utilize the Precedence Diagram Method (PDM) and be depicted in Gantt Chart view.
2. All schedules shall be submitted to the DEN Project Manager electronically in PDF format and in a dynamic format that will allow import/export, manipulation, and generation of report(s) to evaluate and review any part of the schedule.
3. Export file shall use the following naming convention. For example, 161510 BL – Parking Structure MOD4E Baseline
  - a. Project ID: To be assigned at Schedule Conference Meeting, i.e., 161510
  - b. Project Name: Reference Project Manual for Project Name, i.e., Parking Structure MOD 4E
  - c. Identify schedule type: Baseline, Update or Revision, i.e., BL, U, and R
4. All schedules shall contain a title block showing:
  - a. Project name.
  - b. Contractor number.
  - c. Contractor's name.
  - d. Data date.

- e. Symbol legend.
5. All schedules shall contain a time-scale at the top showing month and weeks.
6. The activity table layout shall include, but not limited to, the following columns:
  - a. Activity ID.
  - b. Activity name.
  - c. Original duration.
  - d. Schedule percent complete.
  - e. Start date
  - f. Finish date
  - g. Total Float.
7. A narrative report shall accompany all schedules.
8. A mitigation report shall be required when at the discretion of either party it becomes apparent that the project is not progressing on time regardless of the cause of delays and impacts, or issued construction changes have negative impact and require a mitigation effort through several viable alternatives. The mitigation report shall detail the measures proposed by the Contractor to mitigate the impacts of the delay in order to meet the planned project completion date.

#### 1.5 PRELIMINARY CONSTRUCTION SCHEDULE:

##### A. Gantt Chart Schedule

1. Submit Gantt chart-type CPM Construction Schedule at the pre-construction meeting.

##### B. Preparation

1. Indicate each significant construction activity separately.
2. Identify first workday of each week with a continuous vertical line.
3. Outline significant construction activities for first sixty (60) days of construction.
4. Include skeleton diagram for the remainder of the Work.
5. The Preliminary Schedule shall show all significant work tasks that occur in the first sixty (60) days, including planning, mobilization, shop drawings and technical submittals and approval time, procurement, fabrication and construction.
6. It shall identify work items or milestones that affect or are affected by City, other Contractor's work, utilities, and other third parties and it shall list major submittals required by the Contract.

##### C. Narrative

1. The Preliminary Schedule shall be accompanied by a narrative describing the Contractor's approach to mobilization, procurement, and construction during the first sixty (60) days.
2. The narrative shall elaborate based on durations, production rates, major equipment to be used, and shall identify all major assumptions used to develop the schedule.

- D. Approval of Preliminary Construction Schedule will not constitute approval of Schedule of Values.
- E. The DEN Project Manager will respond within 14 days to the Preliminary Schedule submittal with either acceptance or direction to revise and resubmit.
- F. In lieu of the Preliminary Schedule, the Contractor may, at the Contractor's own discretion, submit the Construction Schedule at the Preconstruction Meeting. If the Construction Schedule is submitted in lieu of the Preliminary Schedule, the DEN Project Manager will respond within thirty (30) days with acceptance or direction to revise and resubmit within ten (10) days.

#### 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. The Contractor shall submit the Initial Construction Schedule thirty (30) days after the Notice to Proceed (NTP). Upon acceptance from the DEN Project Manager and the DEN Scheduler, the Initial Construction Schedule shall become the Baseline Schedule for the duration of the project.
- B. The DEN Project Manager will respond within 14 days with acceptance or direction to revise and resubmit.
- C. Failure of the contractor to have a Construction Schedule accepted by DEN Project Manager will be considered cause for withholding progress payment.
- D. The acceptance of the schedule is for general conformity to the Contract requirements and shall not constitute any relief of any Contract requirements.
- E. Failure to include any work item required for performance of this Contract shall not excuse the Contractor from completing all Work within applicable completion dates, regardless of the City's acceptance of the schedule.
- F. Preparation:
  - 1. Project Duration
    - a. Extend schedule from date of established for the NTP to date of Substantial Completion and Final Completion.
    - b. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically amended by Change Order.
  - 2. Activities
    - a. Treat each building floor or separate area as a separate numbered activity for each main element of the Work. Prepare a list of all activities required to complete the Work and indicate the estimated time duration, sequence requirements, and relationships of each activity in relation to the other activities.

3. Activity Duration:
  - a. Define activities so no construction activity is longer than twenty (20) days, unless specifically allowed by DEN Project Manager. Include estimated time frames for the following activities:
    - 1) Preparation and processing of submittals.
    - 2) Mobilization and demobilization.
    - 3) Purchase of materials.
    - 4) Delivery of materials.
    - 5) Fabrication of materials
    - 6) System shutdown request and approval
    - 7) Utility/system interruptions
    - 8) Installation
    - 9) Work by City, other contractors, utilities and other third parties that may affect or be affected by Contractor's activities.
    - 10) Startup, Testing and Commissioning
    - 11) Punch list and Final Completion.
4. Critical Path Activities:
  - a. No more than twenty-five (25) percent of the activities may be on the critical path, unless approved IN WRITING by DEN Project Manager.
  - b. Identify critical path activities, including those for interim completion dates.
  - c. Scheduled start and completion dates shall be consistent with Contract milestone dates.
5. Procurement Activities:
  - a. Include procurement activities for long lead items and major items as separate activities in schedule.
  - b. Procurement cycle activities including, but are not limited to, submittals, approvals, purchasing, fabrication and delivery.
6. Submittal Review Time:
  - a. Include review and re-submittal times indicated in Technical Specification 013300 "Submittal Procedures" in schedule unless time frame is reduced by approval of the DEN Project Manager.
  - b. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
7. Substantial Completion:
  - a. Indicate date established for Substantial Completion.
8. Constraints:
  - a. Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the

Work is affected.

- 1) Phasing:
  - a) Arrange list of activities in schedule by phase or Work Breakdown Structure (WBS).
  - b) Coordinate phasing and constraint with those established in Technical Specification Section 011400 "Work Sequence and Constraints".
- 2) Products Ordered in Advance:
  - a) Include separate activity for each product.
  - b) Include delivery date indicated in Technical Specification Section 011100 "Summary of Work".
  - c) Delivery dates indicated stipulate the earliest possible delivery data.
- 3) Owner-furnished Products:
  - a) Include separate activity for each product.
  - b) Include delivery date indicated in Technical Specification Section 011100 "Summary of Work".
  - c) Delivery dates indicated stipulate the earliest possible delivery date.

9. Milestones:

- a. Include milestone indicated in the Contract Documents in schedule, including, but not limited to, the NTP, phasing requirements, Substantial Completion and Final Completion.

- 1) Resource Loading of Construction Schedule:
  - a) Coordinate with DEN Project Control Staff and DEN Project Manager for the requirements below
  - b) Activities shall be resource loaded with direct man-hours required to perform the physical construction of the project. Indirect man-hours shall not be included as resources to activities.
- 2) Contract Modifications:
  - a) For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change to the overall project schedule

1.7 CONSTRUCTION SCHEDULE MONTHLY UPDATES

- A. The Contractor shall submit a monthly progress schedule at the end of each month

- following the NTP. At the end of each month, the Contractor and DEN Project Manager shall agree on the progress of the work and the Contractor shall update the Construction Schedule accordingly. This review does not constitute an acceptance of the Construction Schedule and shall not be used for the purpose of modifying the initially accepted Construction Schedule.
- B. Failure of the Contractor to have a Construction Schedule accepted by the DEN Project Manager will be considered cause for withholding progress payment per Article 306 - Working Hours and Schedules and Article 909 - Additional Withholding of Progress Payments of the General Contract Conditions, 2011 Edition.
- C. The Contractor's monthly progress schedule shall include a written narrative describing the overall progress of the Work, provide a critical path analysis, discuss significant problems with proposed corrective action, and how the status of major changes and any other changes are affecting the project schedule.
- D. Concurrent with making revision to the schedule, prepare a tabulated report showing the following and include in the narrative report:
1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations-for remaining work activities only.
  5. Changes in critical path.
  6. Change in total float
  7. Changes in contract duration.
- E. Changes to the Schedule:
1. The Construction Schedule may be changed when one or more of the following events occur:
    - a. When a Change Order significantly affects the contract completion date or sequence of work.
    - b. When the Contractor elects to change the sequence or duration of work items affecting the critical path.
    - c. When the City directs a change that affects a milestone dates specified in the Special Conditions or alters the length of a critical path.
  2. Minor revisions submitted at monthly progress review meeting are not considered as changes in this context.
- F. If, after submitting a request for change to the Construction Schedule, the DEN Project Manager does not agree with the request, the DEN Project Manager will schedule a meeting with the Contractor to discuss the differences. If a settlement cannot be reached on the change in the Construction Schedule, or if the Contractor has failed to submit revisions to the network, the DEN Project Manager has the option of providing suggested logic or duration changes in all subsequent update schedules. The suggested logic and/or duration times will remain in effect until the change in the Construction Schedule is settled or until the logic and duration are superseded.

1.8 AS-BUILT CONSTRUCTION SCHEDULE:

- A. After all Contract Work items are complete, the contractor shall submit an as-built Construction Schedule showing actual start and finish dates for all work items and milestones.

1.9 SCHEDULE NARRATIVES

- A. In addition to the schedule, the Contractor shall submit a narrative that explains the basis for the Contractor's determination of construction logic.
- B. It shall include estimated quantities and production rates, hours per shift, workdays per week, and types, number and capacities of major construction equipment to be used and whether the Contractor plans to work weekends.

1.10 SUBCONTRACTOR COORDINATION

- A. The Contractor shall schedule and coordinate the work of all of its subcontractors and suppliers including their use of the worksite.
- B. The contractor shall keep the subcontractors and suppliers informed of the project Construction Schedule to enable the subcontractors to plan and perform their work properly.

1.11 THREE WEEK LOOK-AHEAD SCHEDULE

- A. The Contractor shall provide the DEN Project Manager an electronic copy prior to and a minimum of four (4) hard copies of the Contractor's Three (3) Week Look-Ahead Schedule for review at the DEN Project Manager's weekly progress meeting.
- B. The schedule shall be in bar chart format based on the approved accepted CPM Baseline Schedule and shall include dates of testing activities, anticipated dates of inspection by DEN and other agencies, activities in progress, percentage of completion of activities, and responsible subcontractor for the activities.

1.12 RECOVERY SCHEDULE

- A. If the latest completion time date for any work item does not fall within the time allowed by the Construction Schedule, the sequence of work or duration shall be revised by the Contractor through concurrent operations, additional manpower, additional shifts or overtime, additional equipment, or alternative construction methods until the schedule produced indicates that all significant contract completion dates, occupancy dates and milestones will be met.
- B. No additional costs will be allowed if such expediting measures are necessary to meet the agreed completion date or dates except as provided elsewhere in the Contract Documents.

- C. When periodic update indicates the Work is behind the current approved schedule, submit a separate Recovery Schedule indicating means by which Contractor intends to regain compliance with the schedule.
- D. Provide a narrative indicating changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished. The narrative shall be submitted in accordance with Article 1105 – Time Extensions in the General Contract Conditions, 2011 Edition.

#### 1.13 CONTRACT EXTENSIONS

- A. If the Contractor is granted an extension of time for completion of any milestone or contract completion date under the provisions of the Contract, the determination of the total number of extended days will be based upon the current analysis of the schedule and upon all data relevant to the extension. Such data shall be incorporated into the next monthly update of the schedule.
- B. The Contractor acknowledges and agrees that delays in work items that, according to schedule analysis, do not affect any milestone dates or the Contract completion date shown on the CPM Network Schedule at the time of the delay will not be the basis for a Contract extension.

#### 1.14 COORDINATION

- A. Pre-scheduling Conference: Schedule conference at Pre-Construction meeting to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to setting up the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - 1. Review content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including phasing, area separations, interim milestones, and partial Owner occupancy.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review submittal requirements and procedures.
  - 6. Review time required for review of submittals and resubmittals.
  - 7. Review time required for Shutdown request and approval.
  - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
  - 10. Review procedures for updating schedule.
  - 11. Review requirements for content and input of direct man-hour resources in activities.
  - 12. Review requirements for cost loading of activities.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values.



- C. Work items in the Construction Schedule shall be identified in a Work Breakdown Structure (WBS) format that corresponds with the technical specifications.
- D. At a minimum WBS shall correspond to the first tier level of the Master Format.
- E. Secure time commitments for performing critical elements of the Work from entities involved.
- F. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **013210**

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## SECTION 013223 - CONSTRUCTION LAYOUT, AS-BUILT AND QUANTITY SURVEYS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section covers Denver International Airport (DEN) procedures and accuracy requirements for survey services for construction layout, as-built, and quantity surveys.
- B. Before commencing any field surveys on DEN property, the Contractor shall coordinate a pre-survey preparation activities meeting. This meeting is to be arranged through the Denver International Airport (DEN) Project Manager's Office with the attendance of the Contractor, the Contractor's surveyor and the DEN Survey Section. The Contractor is responsible for obtaining DEN related survey guidance, National Geodetic Survey (NGS) control stations, projection parameters, and training materials from the DEN Survey Section prior to beginning any survey work.
- C. Reference Contract General Conditions.
- D. Survey Project Checklist, provided after the end of this Section, will be reviewed at the pre-survey preparation activities meeting.

#### 1.3 REFERENCE DOCUMENTS:

- A. Section 013300 "Submittal Procedures"
- B. Section 013325 "Shop and Working Drawings, Product Data and Samples".
- C. Federal Aviation Administration Advisory Circular 150/5300-16A - "General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey".
- D. Federal Aviation Administration Advisory Circular 150/5300-17C - "Standards for Using Remote Sensing Technologies in Airport Surveys".
- E. Federal Aviation Administration Advisory Circular 150/5300-18B - "General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards".
- F. DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and

Construction Plan Manual, Technical Specifications Division 1.

G. Colorado Department of Transportation (CDOT) Survey Manual.

#### 1.4 SUBMITTALS

A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process.

B. Survey Statement of Work (SSOW):

1. The Contractor must develop a complete SSOW and submit it to the DEN Project Manager. The SSOW is the Contractor's written description of the Contractor's methodology for surveying services that will be provided as part of the Project, including specific features that will be surveyed, action items, timelines necessary airport resources and general information.
2. SSOW must be submitted within ten (10) working days of the Notice to Proceed (NTP) and prior to commencement of any survey or layout work on the site.
3. The SSOW will be reviewed and approved by the DEN Survey Section. Under no circumstances will work begin until the SSOW has been accepted. Review comments and/or approval will be sent to the DEN Project Manager within three (3) working days of the delivery of such document to the DEN Survey Section.

C. Survey and layout data must be submitted in the format indicated below. The data must be submitted immediately after completion and shall be certified and/or stamped by a current Colorado Registered Professional Land Surveyor where it is required by the Contract Documents.

1. All Raw Data files, either GPS, digital levels or conventional total station must use a Trimble format.
2. All copies of original pages of field notes or electronic field notes must be in Adobe Portable Document Format (PDF).
3. All original field notebooks used for this Project must be submitted at the end of Contract.
4. All as-built points files must be in either CSV or TXT format.
5. All CAD drawings must be in Autodesk Civil 3D format.
6. CAD layers are specified in DEN Design Standards Manual Volume 12.
7. DEN will provide the Autodesk Civil 3D drawing template.

D. Survey and Quality Control Plan (SQCP):

1. The Contractor must develop a complete SQCP and submit it to the DEN Project Manager. The SQCP is the Contractor's written description detailing the Contractor's methodologies for data collection, data safeguarding and quality assurance. Provide insight on how the Contractor will completely check all data to ensure it is complete, reliable, and accurate. Identify data safeguards used to protect this sensitive and safety critical data. Utilize a checklist based quality control process with definable and repeatable standards for each element ensuring consistency of work between different personnel within an organization.

Submit the plan in a non-editable format such as Adobe Portable Document Format (PDF).

2. The SQCP must be submitted within ten (10) working days of the NTP and prior to commencement of any survey or layout work on the site.
3. The SQCP will be reviewed and approved by the DEN Survey Section.
4. Under no circumstances will Survey work begin until the SSOW has been accepted. Review comments and/or approval will be sent to the DEN Project Manager within three (3) working days of the delivery of such document to the DEN Survey Section.

E. Weekly Project Status Report:

1. Submit a project status report via email DEN Project Manager every Monday by 2:00 P.M. Mountain Time, from the date of the task order until the date of Substantial Completion. Include in the reports the percentage complete for each of the major portions of the Work with the estimated completion date or completion date. Provide the status of ongoing work, with expected completion dates, and any unusual circumstances and/or deviations from this guidance. Status reports should be brief and contain the current information in the text of the email. See the example of a Project Status Report as provided after the end of this Section.

F. Final Project Survey Report:

1. The Final Project Survey Report, if required, use format from AC 150/5300-18B 2.6.4.
2. Final Project Survey Report must be stamped and signed by a current Colorado Registered Professional Land Surveyor.

## 1.5 EQUIPMENT

A. Equipment Calibration:

1. Equipment must be regularly checked, and calibrated for accuracy at the beginning of any survey project to ensure that the equipment is operating appropriately. Errors due to poorly maintained or malfunctioning equipment will not be accepted. If any equipment errors are found to exist, they must be reported to the DEN Survey Section prior to the start of any surveying. These errors will need to be verified and eliminated prior to performing any survey work. For projects lasting longer than six (6) months, the checking, and calibration of equipment shall be repeated. Furthermore, documentation must verify such equipment has met acceptable tolerances.
2. The Contractor MUST submit to the DEN Project Manager written proof that survey equipment, as listed in the SQCP plan has been checked and calibrated before commencing any survey work. This could be in the form of field notes. If repairs are made, documentation of such repairs from an authorized equipment vendor is required

B. See CDOT Survey Manual for acceptable procedures for calibrating equipment

electronic survey instruments adjustments, calibration or repairs:

1. All electronic survey instruments shall be repaired, adjusted, or calibrated only by an authorized equipment vendor or manufacturers service department.
2. A calibration check on all types of electronic survey instrumentation is essential to obtain and maintain the tolerances required for any DEN project. At the beginning of any DEN project, all survey equipment utilized to perform the survey shall be calibrated by the surveyor in charge of the Project.
3. See CDOT Survey Manual for acceptable procedures for calibrating equipment.

C. Baseline Calibration Requirements:

1. See CDOT Survey Manual for the procedures to check the survey equipment and the method of reporting the findings to the DEN Project Manager and the DEN Survey Section.
2. The Contractor MUST submit to the DEN Project Manager written proof that survey equipment has been checked and calibrated before commencing any survey work. This could be in the form of field notes. If repairs are made, documentation of such repairs from an authorized equipment vendor is required.

1.6 SURVEY CONTROL

- A. All airport construction project surveys MUST USE the most current coordinate system. No prior coordinate systems are supported. Surveys MUST utilize the most current coordinate system for collecting construction as-built information.
- B. Since the DEN LDP utilized the NAD83 (2007) data, all NGS horizontal points MUST use the NAD83 (2007) data. The DEN Survey Section will provide this data during the mandatory pre-survey preparation activities meeting. The DEN Survey Section will also provide coordinates for all NGS Control Points in DEN LDP based upon the location of the Project.
- C. Since DEN has established NGS horizontal control points, the Contractor MUST use the published latitudes, longitudes, and heights with the projection parameters for these control points that are received and NOT the DEN LDP rectangular coordinates for base station setups for the Geodetic Verification Survey. The Contractor must verify each NGS Horizontal and Vertical primary control point stations by:
1. Physically visiting each control station to determine its usability and checking its identity.
  2. Ascertaining its unmoved position.
  3. Determining its condition, stability, visibility.
  4. The submission of a recovery report to NGS if one has not been recently recorded.
- D. Geodetic Verification Survey Instructions and Procedures:
1. The geodetic verification survey is created to insure the stable position of the DEN control points that are used to reference the temporary design/construction

control points to the National Spatial Reference System (NSRS). Acceptable monuments will be identified by the DEN Survey Section and will be limited to monuments of the NSRS with permanent identifiers (PIDS) and published positions and elevations. Temporary design/construction control points established for such project will be referenced by direct measurement to at least two (2) separate NGS control stations

- a. The Contractor will attempt to recover each identified monument and determine its condition, stability, and suitability for the intended use. A location sketch and visibility diagram will be prepared for each station. A minimum of three (3) digital photographs, one of each type described in AC 150/5300-18B, Section 1.5.2.1, will be captured, captioned, and properly named. A recovery note will be filed with NGS if no current recovery is shown in the NSRS database.
- b. After recovering the identified NSRS NGS control stations that are located on DEN property, the procedure to verify the control points are as follows:
  - 1) When using a remote GPS base station on the airfield, the Contractor must occupy the Primary Airport Control Station (PACS) and observe the Secondary Airport Control Station (SACS) for a duration of at least ten (10) minutes (600 epochs), along with a five (5) second collection interval. Then reverse the setup, occupy the SACS and observe the PACS for a duration of at least ten (10) minutes (600 epochs), along with a five (5)-second collection interval. The end results are two (2) independent GPS observations. Compare the newly measured distances or inverse distances (from new observations) against the distances determined from the published positions. Submit results to the DEN Survey Manager and DEN Survey Section in Microsoft Excel format.
  - 2) When using a Virtual Reference Station (VRS) on the airfield, the Contractor must observe the PACS and the SACS for a duration of at least ten (10) minutes (600 epochs), along with a five (5)-second collection interval. Then reverse the setup, occupy the SACS and observe the PACS for a duration of at least ten (10) minutes (600 epochs), along with a five (5)-second collection interval. The end results are two (2) independent GPS observations. Compare the newly measured distances or inverse distances (from new observations) against the distances determined from the published positions. Submit results to the DEN Survey Manager and DEN Survey Section in Microsoft Excel format.
  - 3) When using conventional methods on the airfield, measure the distance between the PACS and SACS using a calibrated electronic distance meter instrument (EDMI). Compute either the inverse using the NGS program INVERS3D (available on the NGS website at <http://www.ngs.noaa.gov/TOOLS/>) or a comparable commercial product. Compare the newly measured distances or inverse distances, from new observations, against the distances determined from the published positions. Submit results to the DEN Survey Manager and DEN Survey Section in Microsoft Excel format.

- 4) Obtain elevation checks either from GPS observations or from digital levels. The distances must agree within, plus or minus, three ( $\pm 3$ ) cm; the difference in ellipsoidal height must agree within, plus or minus, four ( $\pm 4$ ) cm, and the difference in orthometric height must agree within, plus or minus, five ( $\pm 5$ ) cm. If the tolerances are not met, the data must be recollected.
- 5) Provide the results or the comparisons as part of the observational data in a report to the DEN Project Manager to be reviewed and approved by the DEN Survey Section prior to the start of construction and include this approved report in the final report.
- 6) Submit a recovery report for the NGS horizontal control stations to the NGS.

E. The Following are Limitations and Additional Information on NGS Control Stations and NGS Benchmarks (Refer to the NGS website.):

1. The use of control monuments and projection parameters for construction layout other than those shown on the Contract Drawings or furnished by or approved by the DEN Survey Section is STRICTLY PROHIBITED. Use of other monuments is solely at the risk of the Contractor.
2. The DEN Survey Section will provide the contractor with the projection parameters and any assistance in implementing the current coordinate system. It is up to the Contractor to use the correct methodology in performing any survey task that shall be submitted to the DEN Project Manager and reviewed during the pre-survey preparation activities meeting.
3. The DEN Survey Section will need all pertinent data from the contractor to check and verify that the Contractor implemented the current coordinate system correctly.

F. Modifications to AC 150/5300-18B, Section 2.6.10.1.1, Verification of Survey Marks:

1. DEN is modifying the requirement for verification of PACS and SACS and is replacing it with a requirement to verify the unmoved position and elevation of both the PACS and SACS for any airside projects and any two (2) DEN approved NGS horizontal control stations for any landside project.
2. The surveyor must follow the same verification procedure as stated in paragraph 1.6.C of this Section.

G. Reporting Damage or Errors of NGS Control Stations:

1. Report damaged or destroyed airport control points, benchmarks, and section corner monuments promptly to the DEN Project Manager.
  - a. If section corner monuments are damaged or destroyed during construction activities, such points shall be re-established pursuant to Laws of the State of Colorado Regulating the Practice of Land Surveying by a Registered Professional Land Surveyor in the State of Colorado.
  - b. If NGS control stations or NGS benchmarks are damaged, moved, altered, or destroyed by the Contractor, the City's cost of reestablishing such points

- shall be borne by the Contractor.
- c. The City will not be responsible for any increased costs or delays to the Contractor relating to reference points, airport control points, or benchmarks that are damaged, moved, altered, or destroyed by the Contractor or its subcontractors, suppliers, agents or employees or other Contractors working on the site.
2. Report alleged errors in NGS control stations or NGS benchmarks promptly to the DEN Project Manager.
    - a. Discontinue use of NGS control stations or NGS benchmarks alleged to be in error until the accuracy of points can be verified or as directed.
    - b. Claims for extra compensation for alteration or reconstruction allegedly due to errors in NGS control stations or NGS benchmarks will not be allowed unless original NGS control stations and NGS bench marks still exist or substantiating evidence proving error is furnished by the Contractor, and unless the Contractor has reported such errors to the DEN Project Manager as specified herein.

## 1.7 TEMPORARY SURVEY CONTROL

- A. The Contractor MUST set a minimum of 1" copper plug; a PK (surveying) nail in asphalt or a 5/8" rebar with cap stamped "Control Point" and the Surveyor's Professional Land Surveyors' number, in natural ground. Any other type of material used for control points MUST be approved first.
- B. When a contractor establishes temporary control points for DEN survey work the Contractor MUST follow FAA guidelines. All temporary control points must be referenced to the NSRS using the NGS control stations provided by the DEN Survey Section. Temporary control may be necessary based on project site location. Below are the acceptable means to establish temporary geodetic control for DEN design or construction projects:
  1. Temporary control must be established under close cooperation with the DEN Survey Section following the procedures outlined in AC150/5300-16 "General Guidance and Specifications for Aeronautical Surveys.
  2. Establishment of Geodetic Control and Submission to National Geodetic Survey" shall be required only in the following cases:
    - a. Large airport airfield construction project that significantly changes the airport geometry and would trigger the need to acquire new Digital Stereo Imagery following AC 150/5300-17 "General Guidance and Specification for Aeronautical Survey Airport Imagery Acquisition and Submission to the National Geodetic Survey". Examples include a new runway and taxiway complex, significant modification of existing runway or taxiway system, development of new outboard deice pad complex or establishment of new mid airfield concourse and terminal complex. The size and complexity of the Project will dictate the need to acquire new digital stereo imagery for significant construction.



- b. Construction that establishes a new ILS CAT II/III Operations.
  - c. New Instrument Development Procedure.
  - d. New Airport Layout Plan Survey Update.
  - e. New Airport Obstruction Chart Update.
  - f. New Airport Mapping Database.
3. On DEN construction projects, the Contractor, excluding large airport airfield construction projects, may use temporary control points on their project site. These temporary control points must be referenced to the nearest DEN primary control points and **MUST BE** referenced vertically to two (2) different benchmarks. Also, all surveyors **MUST** obtain permission to establish temporary control points on DEN property by means of communicating with the DEN Survey Section.
4. In addition, all vertical control **MUST BE** established only using a digital level and collected using the digital software to reduce transposition errors unless otherwise authorized by the DEN Survey Section.
5. Minimum Construction Horizontal and Vertical Accuracy Tolerance:
  - a. Adjustments:
    - 1) No Horizontal adjustment of the survey field data will be permitted without the written consent of the DEN Project Manager and the DEN Survey Section. If it is determined that an adjustment is necessary, a weighted least squares adjustment method is recommended.
  - b. Primary Control Benchmark Minimum Vertical Accuracy Tolerance:
    - 1) Setting of primary control benchmarks shall meet the Minimum Vertical Accuracy Tolerance of a NGS Second Order Class II as the square root of the total horizontal distance of the level loop in miles multiplied by 0.035 feet.
    - 2) The Primary Control Benchmarks must be NGS Published Vertical Points.
  - c. Secondary Control Benchmark Minimum Vertical Accuracy Tolerance:
    - 1) Setting of secondary control benchmarks for construction shall meet the Minimum Construction Vertical Accuracy Tolerance of the square root of the total horizontal distance of the level loop in miles multiplied by 0.035 feet.
6. Whether establishing temporary control points or not, the Contractor must set up a pre-survey preparation activities meeting with the DEN Project Manager and DEN Survey Section to discuss Geodetic Control Verification, obtain pertinent survey data, and projection parameters before the commencement of any survey work.
7. If temporary control points are needed, the Contractor can set and collect temporary control while performing as outlined in Part 1 of this Section. This procedure requires a ten (10) minute (600 epochs) for each temporary control point set. Once the data is collected the Contractor is required to submit to the

DEN Project Manager all GPS raw data in a Trimble format with a spreadsheet that displays the comparison from each observation of the NGS control stations and the Contractor's temporary control points. Only the redundant values of the temporary control points should be averaged. The results must be reviewed and approved by the DEN Survey Section, allowing at least seventy-two (72) hours to review and either approve or reject the temporary control. All temporary control points MUST BE accepted before any survey construction work can commence.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 CONSTRUCTION LINES AND GRADES**

- A. The Contractor's surveyor shall make surveys and layouts as necessary to delineate the Work. As a part of such surveys, the Contractors Surveyor shall furnish, establish, and maintain in good order, survey control points that may be required for the completion of the Work
- B. The DEN Project Manager shall have the right to check surveys and layouts made by the Contractor prior to approving any of the Work. The Contractor shall give advance notice of not less than forty-eight (48) hours to the DEN Project Manager to enable such checking prior to placing any work. The Contractor shall furnish assistance as may be required for checking purposes when so requested by the DEN Project Manager.
- C. The Contractor shall furnish skilled labor, instrument platforms, ladders, and such other temporary structures as may be necessary for making and maintaining points and lines in connection with the surveys required.
- D. DEN may draw the Contractor's attention to errors or omissions in lines or grades, but the failure to point out such errors or omissions shall not give the Contractor any right or claim nor shall in any way relieve the Contractor of obligations according to the terms of this Contract
  - 1. The Contractor's Surveyors instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards and in proper operating condition and adjustment at all times. Surveys shall be performed under the direct supervision of a current Colorado Registered Licensed Surveyor.
- E. Field Notes:
  - 1. The Contractor shall record surveys in field notebooks or as electronic field notes, whichever is more appropriate to the type of survey work. Copies of the original pages of field notebooks shall be furnished to the DEN Project Manager and the DEN Survey Section at intervals required by the DEN Project Manager.

Each field notebook shall be furnished to the DEN Project Manager when filled or at completion of project. No erasures are allowed on the data entered in the field book. Cross out errors, and write correct entries above. The person that makes correction in the field book should initial above corrections made. An explanatory note shall be made for all corrections to original figures. All editing of computer records shall be done on a copy of the original with all changes initialed.

Electronic data from data collectors shall be provided in formats in accordance with DEN Design Standards Manual Volume 12 and Construction Plan Manual Technical Specifications Division 1. These will be used to supplement field books and shall be supplied to the DEN Project Manager and DEN Survey Section on Compact Disk (CD).

2. If the DEN Project Manager or DEN Survey Section finds errors in the field notes DEN will have the Contractor correct and resubmit the notes. This review does not relieve the Contractor from the responsibility of maintaining accurate survey data. Whichever method of note taking the Contractor starts with, the Contractor must use the same method throughout the Contract duration.

### 3.2 SUBSURFACE UTILITIES ENGINEERING (SUE)

- A. Refer to Section 011810 "Utilities Interface" for information related to underground utilities.

### 3.3 QUANTITY SURVEYS FOR PAYMENT

- A. When the specifications or the DEN Project Manager requires items in the Schedule of Prices and Quantities to be measured by surveying methods, the Contractor shall perform the surveys. All such surveys, including Horizontal and Vertical control surveys run for establishing the measurement values shall be performed in the presence of the DEN Project Manager and the DEN Surveyor may witness the surveying operation. The Contractor will reduce the field notes and calculate final quantities for payment purposes. The note reductions and calculations shall be submitted to the DEN Project Manager.

### 3.4 SURVEYING ACCURACIES AND TOLERANCES IN CONTROL SURVEYS, CONSTRUCTION LAYOUTS AND QUANTITY CALCULATIONS

- A. See CDOT Survey Manual or FAA Specifications for acceptable tolerances.

### 3.5 CAD DRAWINGS PER DEN GIS LAYER STANDARDS

- A. Where CAD drawings are required, follow DEN BIM DSM.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

**PART 6 - Survey Checklist**

| Step | Yes                      | No                       | N/A                      | Project Kickoff Phase                                                                                                                                               |
|------|--------------------------|--------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor meet with DEN PM obtain the data standards and general requirements for data gathering?                                                   |
| 2    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor meet with Airport Survey Office to obtain airport survey control points, projection parameters, and airport survey training materials?    |
| 3    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor provide Survey Statement of Work to DEN PM?                                                                                               |
| 4    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor provide Geodetic Verification Survey to DEN PM?                                                                                           |
| 5    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor provide Survey Control Plan to DEN PM?                                                                                                    |
| 6    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor provide Imagery Plan to DEN PM? (Only required if collecting aerial imagery)?                                                             |
| 7    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did the FAA accept survey plans?                                                                                                                                    |
| Step | Yes                      | No                       | N/A                      | Construction Phase (As-Built)                                                                                                                                       |
| 8    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor perform field survey of project site to collect accurate as-built data?                                                                   |
| 9    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did the Consultant/Contractor provide DEN PM with subsurface utility data?                                                                                          |
| 10   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Each week, did the Consultant/Contractor provide DEN PM with Project Status Reports?                                                                                |
| 11   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did the Consultant/Contractor provide DEN PM with 30% as-built data in both CADD and GIS formats including all attribute information and metadata?                  |
| 12a  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did DEN PM report 30% QA findings via email to Consultant/Contractor?                                                                                               |
| 12b  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | If required, did the Consultant/Contractor provide DEN PM with 60% as-built data in both CADD and GIS formats including all attribute information and metadata?     |
| 12c  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | If applicable, did DEN PM report 60% QA findings via email to Consultant/Contractor?                                                                                |
| 12d  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | If required, did the Consultant/Contractor provide the DEN PM with 90% as-built data in both CADD and GIS formats including all attribute information and metadata? |
| 12e  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | If applicable, did DEN PM report 90% QA findings via email to Consultant/Contractor?                                                                                |
| 13   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did the Consultant/Contractor provide DEN PM with 100% as-built data in both CADD and GIS formats including all attribute information and metadata?                 |
| 14   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did Consultant/Contractor provide DEN PM with a completed Final Survey Report?                                                                                      |
| 15   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Did DEN PM report QA findings via email to Consultant/Contractor?                                                                                                   |

**PART 7 - SAMPLE OF A WEEKLY PROJECT STATUS REPORT:**

-----  
Anywhere Field/Anywhere International Airport

AIP X-XX-XXXX-XXX-20XX

Survey progress update #1

July XX to July XX

Eagle Eye Surveying completed a second week of ground surveying. The first week verified PACS and SACS control, collected runway centerline, and primary surface topographic information.

To date we have surveyed for Runway 12-30:  
Airport Control (PACS, SACS, ANY B540) 100%  
Runway and Stop way Ends 100%  
NAVAIDS (VOR, NDB, Airport Beacon, VASI, PAPI, and REILs) 100%  
Runway and Stop way Obstructions (Primary surface, approaches, transitional surfaces) 100%  
Aircraft Movement and apron areas 75%  
Prominent airport buildings / potential close-in obstructions 42%

This week we will be analyzing the collected obstruction survey data relative to the object identification surfaces. We will check both the required points for each obstruction zone and the navigational aids, and generate the appropriate field documentation. We completed subcontract negotiations with aerial photography sub consultant SkyCamera, Inc. and are submitting the proposed flight map with ground reference points for review and approval before completing our final week of field surveying. This week we will be setting aerial targets and surveying in the targets and Photo ID points, and collecting final outlying obstruction data. Aerial photography is promised to us 2 to 4 days after our targets are in place.

Sincerely,

Any Surveyor, P.S.  
Eagle Eye Surveying

-----  
**END OF SECTION 013223**

## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  1. Preconstruction photographs.
  2. Periodic construction photographs.
  3. Final Completion construction photographs.
  4. Preconstruction video recordings.
  5. Periodic construction video recordings.
  6. Web-based construction photographic documentation.

#### 1.3 REFERENCE DOCUMENTS:

- A. Section 013300 "Submittal Procedures"
- B. Section 017720 "Contract Closeout"
- C. Section 017900 "Demonstration and Training"
- D. Section 024116 "Structure Demolition"
- E. Section 024119 "Selective Demolition"
- F. Section 311000 "Site Clearing"

#### 1.4 ALTERNATES

- A. Refer to Section 012300 "Alternates"

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [photographer] [and] [Web-based photographic documentation service provider].
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points

marked for location and direction of each **[photograph]** **[video recording]**. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

- C. Digital Photographs: Submit image files within **[three (3)]** **<Insert number>** days of taking photographs.
1. Digital Camera: Minimum sensor resolution of **[10]** **<Insert number>** megapixels.
  2. File Format: Minimum **<Insert resolution>** pixels, in unaltered .RAW original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
  3. Identification: Provide the following information with each image description in file metadata tag:
    - a. Project title and Project number.
    - b. Name and contact information for photographer.
    - c. Name of DEN Project Manager.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      - 1) Include work order number or change order number if applicable.
    - g. Unique sequential identifier keyed to accompanying key plan.
    - h. Photograph number.
- D. Construction Photographs: Submit **[two (2)]** **<Insert number>** prints of each photographic view within **[seven (7)]** **<Insert number>** days of taking photographs.
1. Format: **[8-by-10-inch]****<Insert size>**. smooth-surface matte prints on single-weight, commercial-grade photographic paper; **[mounted on linen or card stock to allow a 1-inch-wide margin and]** **[enclosed back to back in clear plastic sleeves that are]** punched for standard three-ring binder.
  2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of DEN Project Manager.
    - d. Name of Contractor.
    - e. Date photograph was taken if not date stamped by camera.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Unique sequential identifier keyed to accompanying key plan.
- E. Video Recordings: Submit video recordings within **[seven (7)]** **<Insert number>** days of recording.
1. Submit video recordings in an electronic format acceptable to DEN Project



- Manager **[by posting to Project Web site]** **[by posting to Web-based photographic documentation service provider's Web site]**. Recordings shall be high-resolution **[720p]** **[1080p]****[4k]****[8k]** with a minimum framerate of 60Hz
2. Identification: With each submittal, provide the following information:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of DEN Project Manager.
    - d. Name of Contractor.
    - e. Date video recording was recorded.
    - f. Description and key plan of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Weather conditions at time of recording.
- F. Web-Based Photographic Documentation: Submit time-lapse sequence video recordings **[simultaneously with recording]** **[within <Insert number> days of recording]**.
1. Submit time-lapse sequence video recordings by posting to **[Project Web site]** **[Web-based photographic documentation service provider's Web site]** **<Insert posting location>** **[and monthly in digital format]**.
  2. Identification: For each recording, provide the following information:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of DEN Project Manager.
    - d. Name of Contractor.
    - e. Date(s) and time(s) video recording was recorded.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Weather conditions at time of recording.
- 1.6 QUALITY ASSURANCE
- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.
  - B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project for not less than three years.
- 1.7 USAGE RIGHTS
- A. Obtain and transfer copyright usage rights from photographer to City and County of Denver for unlimited reproduction of photographic documentation.

## PART 2 - PRODUCTS

### 2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of [10] <Insert number> megapixels, and at an image resolution of not less than [3200 by 2400] <Insert resolution> pixels.
- B. Digital Video Recordings: Provide high-resolution [720p] [1080p][4k][8k] with a minimum framerate of 60Hz in electronic format acceptable to DEN Project Manager.

### 2.2 WEB-BASED PHOTOGRAPHIC DOCUMENTATION

- A. Project Camera: Provide fixed exterior camera installation, mounted to provide unobstructed view of construction site from location approved by DEN Project Manager.
  - 1. Provide [one] <Insert number> fixed-location camera(s), with the following characteristics:
    - a. [Static view] [Remotely controllable view with mouse-click user navigation for horizontal pan, vertical tile, and optical zoom of [500] <Insert number> percent minimum].
    - b. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Wireless Hand-Held Camera: Provide portable camera system capable of producing images complying with requirements in this Section, with wireless transmission to service provider's network enabling a live image stream viewable by multiple parties.
  - 1. Provide battery charger, spare battery pack, base station hub, and base station connections in a number and distribution adequate to enable wireless camera operation throughout Project site. Contractor responsible for ensuring camera stays in operation.
  - 2. Provide power supply, active high-speed data connection to service provider's network, and static public IP address at base station hub. Provide power supply, conduit, and data wiring between base station hub and base station connections.
- C. Web-Based Image Access: Password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
  - 1. Provide public viewer open access to most recent project camera image.

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to show clearly the Work. Photographs with blurry or out-of-focus areas will not be accepted.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software. Provide commercial quality, digital color photographs in PDF format. PDF file shall be security-free, bookmarked by date with all photos rotated to the correct orientation. Identify the following information on each photograph on the lower right corner.
1. Subject description (include work order number or change order number if applicable)
  2. Station point of camera and direction of view. Include letter size diagram of project indicating Station point
  3. Date and time each photo was taken
  4. Name of Contractor.
  5. Photograph number
  6. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to DEN Project Manager.
- D. Preconstruction Photographs: Before **[commencement of excavation]** **[commencement of demolition]** **[starting construction]**, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by DEN Project Manager.
1. Flag **[excavation areas]** **[construction limits]** before taking construction photographs.
  2. Take **[20]** **<Insert number>** photographs to show existing conditions adjacent to property before starting the Work.
  3. Take **[20]** **<Insert number>** photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
  5. Haul route, laydown yard, and other locations as directed by DEN Project Manager.
- E. Periodic Construction Photographs: Take **[20]** **<Insert number>** photographs

**[monthly, coinciding] [weekly, with timing each month adjusted to coincide]** <Insert time interval> with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

- F. DEN Project Manager-Directed Construction Photographs: From time to time, DEN Project Manager will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Time-Lapse Sequence Construction Photographs: Take **[20] <Insert number>** photographs as indicated, to show status of construction and progress since last photographs were taken.
1. Frequency: Take photographs **[monthly, coinciding] [weekly, with timing each month adjusted to coincide]** <Insert time interval> with the cutoff date associated with each Application for Payment.
  2. Vantage Points: Following suggestions by DEN Project Manager and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than **[two] <Insert number>** of the required shots from same vantage point each time to create a time-lapse sequence as follows:
    - a. Commencement of the Work, through completion of subgrade construction.
    - b. Above-grade structural framing.
    - c. Exterior building enclosure.
    - d. Interior Work, through date of Substantial Completion.
- H. Final Completion Construction Photographs: Take **[20] <Insert number>** color photographs after date of Substantial Completion for submission as project record documents. DEN Project Manager will inform photographer of desired vantage points.
1. Do not include date stamp.
- I. Additional Photographs: DEN Project Manager may request photographs in addition to periodic photographs specified. Additional photographs shall be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice shall be given, where feasible.
  2. In emergency situations, take additional photographs within 24 hours of request.
  3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow-up when on-site events result in construction damage or losses.
    - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    - d. Substantial Completion of a major phase or component of the Work.
    - e. Extra record photographs at time of final acceptance.

- f. DEN's request for special publicity photographs.

### 3.2 CONSTRUCTION VIDEO RECORDINGS

- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Recording: Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- C. Narration: Describe scenes on video recording by **[audio narration by microphone while] [dubbing audio narration off-site after]** video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
1. Confirm date and time at beginning and end of recording.
  2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- D. Preconstruction Video Recording: Before starting **[excavation] [demolition] [construction]**, record video recording of Project site and surrounding properties from different vantage points, as directed by DEN Project Manager.
1. Flag **[excavation areas] [construction limits]** before recording construction video recordings.
  2. Show existing conditions adjacent to Project site before starting the Work.
  3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of **[excavation] [demolition] [construction]**.
  4. Show protection efforts by Contractor.
- E. Periodic Construction Video Recordings: Record video recording **[monthly, coinciding] [weekly, with timing each month adjusted to coincide]** **<Insert time interval>** with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be **[30] <Insert number>** minutes(s).
- F. Time-Lapse Sequence Construction Video Recordings: Record video recording to show status of construction and progress.
1. Frequency: During each of the following construction phases, set up video recorder to automatically record one frame of video recording every **[five (5)] <Insert time>** minutes, from same vantage point each time, to create a time-lapse sequence of **[30 minutes] <Insert time>** in length as follows:
    - a. Commencement of the Work, through completion of subgrade construction.
    - b. Above-grade structural framing.

- c. Exterior building enclosure.
  2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
  3. Vantage Points: Following suggestions by DEN Project Manager [**and Contractor**], photographer shall select vantage points.

### 3.3 WEB-BASED CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

- A. Live Streaming Construction Site Images: Provide Web-accessible image of current site image from [**fixed**] [**viewer-controlled**] location camera(s), updated at [**15**] **<Insert number>** minute intervals during daytime operation.
- B. Time-Lapse Sequence Construction Site Recordings: Provide video recording from a fixed-location camera to show status of construction and progress.
  1. Frequency: Record one frame of video recording every [**15**] **<Insert number>** minutes, from same vantage point each time, to create a time-lapse sequence of construction activities.
  2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
- C. Maintain cameras and Web-based access in good working order according to Web-based construction photographic documentation service provider's written instructions until Final Completion. Provide for service of cameras and related networking devices and software.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **013233**

## **SECTION 013300 - SUBMITTAL PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. The Work specified in this Section summarizes the requirements for the submittal of documents to the DEN Project Manager that are defined in these Specifications. It also describes the procedures for "supplemental" submittals.
- B. The Contractor must follow all the requirements of the procedures and the product details and keep all the submittals current and approved prior to any placement of work.

#### **1.3 SUBMITTAL SCHEDULE**

- A. The Contractor shall provide a submittal schedule within 14 days after Notice to Proceed. The Submittal Schedule shall be directly related to the CPM schedule, shall identify all the submittals, and shall include the following information for each submittal item
  1. Specification section, Contract article, or special condition.
  2. Specification Subparagraph.
  3. Item description.
  4. Date the submittal shall be submitted.
  5. Name of subcontractor or supplier.
- B. The submittal schedule shall be kept current by the Contractor and submitted with the progress payment requests.
- C. For large files that cannot be loaded or e-mailed through the electronic Project Manager application (Unifier), submit the files on a CD, DVD, or USB flash drive media.

#### **1.4 ELECTRONIC SUBMITTALS**

- A. Before the initiation of the submittal process, coordinate and insure that all submittals comply and follow the requirements of the DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and the DEN BIM PXP.

- B. Submit request for progress payment applications utilizing TEXTURA software as instructed by DEN Project Manager.
- C. Submit Subcontractor's Contract information required by the City and County of Denver Small Business Office as instructed by DEN Project Manager.
- D. Submit original electronic copies of all City and County of Denver Development Department/ Building Inspection Department Approved drawings including all approvals of Deferred Submittals; including but not limited to shoring plans, Fire Protection distribution plans, and structural shop drawings to DEN Project Manager as Informational Submittals. The lack of approval of the Denver Development Services on any document shall be basis for rejection of Work and non-compliance.
1. NOTE: Only original copies shall be accepted. Scans will not be accepted.
- E. Submit electronically scanned copies of all documents required by Chapter 17 "Special Inspection and Testing" of the International Building Code 2009 as amended by City and County of Denver 2011. Keep scale and clarify dimension where electronic copies are not as originally scaled and dimensioned.
- F. All submittals shall be delivered to the DEN Project Manager utilizing the Primavera Construction Manager program (PCM) as attachments and as separate file when files are too large to attach or of an electronic media that is not supported by PCM or Utilizing the EPPM Unifier software uploaded to the share drive Unifier's project site when directed by DEN Project Manager.
1. Acceptable electronic formats
- a. Print document format (pdf) shall have no security and bookmark every applicable submittal. All pages shall be completely legible and oriented to correct reading view.
2. Formats are acceptable only with written permission of the DEN Project Manager or required by the BIM PXP. For files in any of the following formats, the corresponding stringency will apply:
- a. Microsoft Office 2007 or newer. All files shall be fully compatible with Microsoft Office 2007.
- 1) AutoCAD files shall be self-contained with no external x-references.
- b. BIM files shall conform to the standards and formats outlined in the BIM PXP and DEN BIM DSM.
- c. Other files pre-approved by the DEN Project Manager.

## 1.5 INITIAL SUBMITTAL

- A. Each submittal document shall include a title block showing the following information:
1. Date of submittal and revision dates.



2. Contract title and number.
  3. The names of Contractor, subcontractor, supplier, manufacturer and when applicable, the seal and signature of an Engineer registered in the State of Colorado, for the involved discipline.
  4. Identification of product by either description, model number, style number or lot number.
  5. Subject identification by Contract Drawing or specification reference.
- B. On each submitted drawing, include a blank space on each sheet, three inches by four inches, in the lower right corner, just above the title block, in which the DEN Project Manager or the Designer of Record may indicate the action taken.
- C. Make submissions sufficiently in advance so that the DEN Project Manager Review may be completed not less than 30 days before Work represented by those submittals is scheduled to be performed.
- D. Allow a minimum cycle of 30 days for review of each submittal by the DEN Project Manager.
- E. Accompany submittal documents with DEN transmittal form CM-30, Submittal, which shall contain the following information:
1. Contractor's name, address and telephone number.
  2. Submittal number and date.
  3. Contract title and number.
  4. Supplier's, manufacturer's, or subcontractor's name, address and telephone number.
  5. Identification of variations from Contract Documents.
  6. Contractor's stamp and signature certifying the Contractor's review.
  7. Identification of submittal:
    - a. If the submittal is being made on a General Condition or Special Condition, reference the General or Special Condition number the first two digits of the specification section shall be 00XXXX.
    - b. If the submittal is being made under a specification section, reference the specification number, paragraph number, and subparagraph number.
    - c. If the submittal is being made under a drawing, reference the drawing(s) number and sub-number.
- F. The Contractor shall describe, at the time of submission, variations from the Contract documents in writing, separate from the submittal document. If the DEN Project Manager approves any such variations, an appropriate Contract change order shall be issued, except that if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued. If a submission contains variations and the variation column is not marked on the transmittal form, it will not be considered for review and acceptance. Along with marking the transmittal as a variation, a description must be included which outlines all the differences including maintenance and utility services along with any cost savings from an item not containing the variation.

- G. Changes in accepted submittal documents will not be permitted unless those changes have been accepted, in writing, by the DEN Project Manager.
- H. The form and quality of submittal documents shall comply with Section 013325 "Shop and Working Drawings, Product Data, and Samples."

#### 1.6 SUPPLEMENTAL SUBMITTALS

- A. Supplemental submittal documents initiated by the Contractor for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals with the appropriate primary transmittal referenced.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### 3.1 CONTRACTOR'S REVIEW

- A. The Contractor shall review all submittal documents, stamp, and sign as reviewed and approved as complying with Contract Documents prior to submission to the DEN Project Manager. Submittal documents that are submitted to the DEN Project Manager **THAT HAVE NOT BEEN REVIEWED BY THE CONTRACTOR** will not be reviewed and will be returned to the Contractor. Contractor is responsible for any delays in the Project due to improperly reviewed, stamped, and signed submittals.
- B. The Owner review period will be limited to ten (10) business days from the time complete submittal documents have been submitted.
- C. The Contractor is responsible to obtain all approvals for all deferred submittals, shop drawings, and significant changes from the CCD Development Service Department.
- D. All submittals must delineate any deviation from the intended design and must submit request for substitution to address any significant variation. Refer to Title 4, Article 405 – Shop Drawings, Product Data, and Samples, and Article 406 – Substitution of Materials and Equipment of the General Contract Conditions, 2011 Edition.

#### 3.2 REVIEW BY DEN PROJECT MANAGER

- A. Submittal documents will be reviewed by the DEN Project Manager, the DEN Project Manager Team, and/or the DOR for conformance to requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. The DEN Project Manager will withhold approval of submittals that depend on other submittals not yet submitted. Review and acceptance will not relieve the Contractor from the Contractor's responsibility for accuracy of submittals, for conformity of submittal document to requirements of Contract Drawings

and specifications, for compatibility of described product with contiguous products and the rest of the system, or for protection and completion of the Contract in accordance with the Contract Drawings and specifications.

- B. The City, the DOR, and/or the DEN Project Manager will review the submittal documents for general conformance with the Contract Documents and mark the Action Code, sign, and date the transmittal.
- C. The Action Codes have the following meanings:
  - 1. Accepted (ACC)
    - a. The submittal conforms to the respective requirements of the contract documents.
  - 2. Accepted as Noted (AAN)
    - a. The submittal conforms to the respective requirements of the Contract Documents after changes are made in accordance with reviewer's comments. AAN submittals do not need to be resubmitted.
  - 3. Revise and Resubmit (R&R)
    - a. The submittal is unacceptable and must be revised and resubmitted.
  - 4. Rejected (REJ)
    - a. The submittal is not approved and a new submittal in accordance with the Contract Documents must be prepared and submitted.
  - 5. For Information Only (FIO)
    - a. An item is received by the DEN Project Manager but is not reviewed.

### 3.3 CONTRACTOR'S RESPONSIBILITIES

- A. Coordinate each submittal document with the requirements of the Work. Place particular emphasis upon ensuring that each submittal of one trade is compatible with other submittals of that trade and submittals of other trades including producing as needed drawings showing the relationship of the Work of different trades.
- B. Contractor's responsibility for errors and omissions in submittal documents and associated calculations is not relieved by the DEN Project Manager's review, correction, and acceptance of submittals.
- C. Contractor's liability to the City, in case of variations in the submittal document from the requirements of the Contract Documents, is not relieved by the DEN Project Manager's review and acceptance of submittals containing variations unless the DEN Project Manager expressly approves the deviation in writing, in which the DEN Project Manager describes the variation.

- D. The Contractor shall maintain a file of all approved submittal documents at the work site. The complete file of approved submittal documents shall be turned over to the DEN Project Manager with the as-built documents at the end of the job.
- E. Schedule impact due to resubmittal requirements is the responsibility of the Contractor.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION **013300**

## SECTION 013325 - SHOP AND WORKING DRAWINGS, PRODUCT DATA, AND SAMPLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting shop and working drawings, product data, samples, and record documents required by other specifications Sections.
  - 1. The Contractor shall submit all shop drawings, working drawings, product data, and samples, as defined in the General Conditions, to the DEN Project Manager in accordance with the requirements in the technical specifications. The DEN Project Manager will return one (1) copy of the shop drawings, working drawings and product data to the Contractor with a written transmittal.
- B. The Contractor shall not submit as shop drawings, copies or reproductions of drawings issued to the Contractor by DEN.
- C. Related Requirements
  - 1. Section 013300 "Submittal Procedures
  - 2. Section 012510 "Substitutions"
  - 3. Section 017720 "Contract Closeout"

#### 1.3 SUBMITTALS

- A. All submittals shall be delivered to the DEN Project Manager in electronic format. All submittals must be of a consistent format (all PDF). No combination of electronic file types will be allowed unless required by a specific specification section.
  - 1. Acceptable electronic formats: Comply with the electronic file formats approved by DEN Building Information Modeling (BIM) Design Standards Manual If any of the files are in any of the formats listed below then the version of the software shall be no less than identified below:
    - a. Adobe Acrobat 8.0 or newer. All files shall be fully compatible with Adobe Acrobat 8.0.
    - b. Microsoft Office 2007 or newer. All files shall be fully compatible with Microsoft Office 2007.

- c. AutoDesk AutoCAD 2007 or newer. All files shall be fully compatible with AutoDesk AutoCAD 2007.
  - d. AutoCAD files shall be self-contained with no external x-references.
  - e. BIM format outlined in the BIM Project Execution Plan (PXP)
  - f. Other files pre-approved by the DEN Project Manager.
2. Adobe Acrobat Requirements:
- a. Drawings shall have security set to "No Security." Commenting, printing, adding photos, form fields and document signing must be allowed.
  - b. PDF submittals shall be one continuous file or Portfolio. No external links are allowed.
  - c. All individual components of submittals shall be bookmarked inside the PDF file.
  - d. All original documents shall be directly converted from the original electronic format to PDF. Scanning of files shall only be allowed by the DEN Project Manager when the original electronic information is not obtainable.
  - e. Failure to comply with these requirements will result in a return of file to the Contractor for immediate revision.
3. Electronic files submitted shall correspond with DEN File Control Numbering System available from the DEN Project Manager.

B. Quantities

1. One (1) electronic submittal in Unifier containing electronic files of each shop or working drawing.
2. One (1) electronic submittal in Unifier containing electronic files of manufacturer's standard schematic drawings.
3. One (1) electronic submittal in Unifier containing electronic files of manufacturer's calculations and manufacturer's standard data.
4. One (1) electronic submittal in Unifier containing electronic files of manufacturer's printed installation, erection, application, and placing instructions.
5. Nine (9) samples of each item specified in the various specification sections, unless otherwise specified.
6. One electronic submittal in Unifier containing electronic files of inspection, test reports, and certificates of compliance.
7. Note: If manufacturer's printed information is in color, all copies of submittals must be in color.

C. Review:

1. Submittal review comments by the DEN Project Manager will be in electronic form and incorporated into the electronic submittal file.
2. Resubmittals of electronic documents shall modify the original electronic file with new information and include the DEN Project Manager's comments with appropriate responses and additional information.

#### 1.4 CHANGES

- A. Changes in products for which shop or working drawings, product data or samples have been submitted will not be permitted unless those changes have been accepted and approved in writing by the Deputy Manager of Aviation as provided in Section 012510 "Substitutions."

#### 1.5 QUALITY CONTROL

- A. Shop drawings and record documents shall be prepared to the standards of quality outlined in the specifications, DSM and BIM PXP, prepared and printed from Revit and checked in the spatial coordination format specified in the BIM PXP.
- B. Refer to DEN BIM DSM for other requirements that may be applicable to this Article.

### **PART 2 - PRODUCTS.**

#### 2.1 SHOP AND WORKING DRAWINGS

- A. Prepare shop and working drawings in an electronic format that is current and approved by DEN to a scale large enough to easily depict and annotate each of the various items.
- B. Comply per other BIM requirements for Shop and Working Drawings as established in the DEN BIM DSM.
- C. Include the following as they apply to the subject:
  - 1. Contract title, work order, and number.
  - 2. Respective Contract drawing numbers.
  - 3. Applicable specification section numbers.
  - 4. Relation to adjacent structure or materials.
  - 5. Field dimensions clearly identified as such.
  - 6. Applicable standards such as ASTM or Federal Specification number, FAA, AASHTO, and pertinent authority specifications or standards.
  - 7. Identification of deviations from the Contract Drawings and specifications.
  - 8. Drawing name, number, and revision.
  - 9. Contractor's stamp, initialed or signed, certifying:
    - a. Verification of field measurements.
    - b. Review of submittals for compliance with Contract requirements.
    - c. Compatibility of the Work shown thereon with that of affected trades.
  - 10. Blank space on each sheet per Technical Specifications Section 013300 "Submittal Procedures."
- D. Drawings of equipment and other items that contain multiple parts shall include

exploded views showing the relationship of parts and the description of the parts into the smallest units that may be purchased or serviced.

- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

## 2.2 PRODUCT DATA

- A. Modify manufacturer's standard and/or schematic drawings to delete information that is not applicable to the Contract. Supplement standard information with additional information applicable to this Contract.
- B. Modify manufacturer's standard(s), diagrams, schedules, performance charts, illustrations, calculations, and other descriptive data to delete information that is not applicable to the Contract. Indicate dimensions, clearances, performance characteristics, and capacities. Include with the submittal electrical, plumbing, HVAC, and any other diagrams, as applicable.
- C. Modify erection, application, and placing instructions to delete information that is not applicable to the Contract or work order.
- D. Include the following:
1. Contract title, work order, and number.
  2. Respective Contract drawing numbers.
  3. Applicable Contract technical specification section numbers.
  4. Applicable standards such as ASTM or Federal Specification number, FAA, AASHTO and pertinent authority specifications or standards.
  5. Identification of deviations from the Contract Drawings and specifications.
  6. Contractor's stamp, initialed or signed, certifying:
    - a. Dimensional compatibility of the product with the space in which it is intended to be used.
    - b. Review of submittals for compliance with Contract requirements.
    - c. Compatibility of the product with other products with which it is to perform or which will be next to it.
    - d. The products electrical, plumbing, control and HVAC requirements conform to Contract Documents and the necessary utilities are provided for in the Contract Documents.
- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

## 2.3 SAMPLES

- A. Submit samples of sizes and quantities to clearly illustrate full color range and functional characteristics of products and materials including attachment devices.
- B. Erect field samples and mockups at the work site as specified in specification Sections and at locations acceptable to the DEN Project Manager. All field samples shall be



erected in a location that will be readily visible throughout the life of the Contract to allow comparison of the Work as it progresses to the field sample. Field samples and mockups may be incorporated into the Work at Contractor's risk if approved by DEN Project Manager.

- C. The Contractor shall verify, through appropriate inspections and tests, that the samples submitted meet the specifications and shall provide inspection and test data with the samples. The review and comments on the sample shall not relieve the Contractor of the Contractor's responsibility for completion of the Contract.
- D. Show the following information:
  - 1. Contract title and number.
  - 2. Respective Contract drawing numbers.
  - 3. Applicable technical specification section numbers.
  - 4. Applicable standards such as ASTM or Federal Specification number.
  - 5. Identification of deviations from the Contract Drawings and specifications
  - 6. Contractor's stamp, initialed or signed, certifying:
    - a. Dimensional compatibility of the product with the space in which it is intended to be used
    - b. Review of submittals for compliance with Contract requirements
    - c. Compatibility of the product with other products with which it is to perform or which will be next to it
  - 7. If multiple samples are submitted and the DEN Project Manager is requested to make a choice, each sample shall have a unique identification number attached to it so the returned transmittal can state the identification number of the accepted sample and the Contractor will know which one it is.
- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

## **PART 3 - EXECUTION**

### **3.1 CONTRACTOR RESPONSIBILITIES**

- A. Verify field measurements, catalog numbers, and similar data.
- B. The Contractor shall not start work for which submittals are required until a transmittal has been received by the Contractor marked with the Action Code ACCEPTED or ACCEPTED AS NOTED by the DEN Project Manager.
- C. Before making submittals, ensure that the products will be available in the quantities and at the times required by the Contract.
- D. Submit final, corrected, electronic copies of Contract and shop and working drawings showing the Work as actually installed, placed, erected, and applied. Refer to Section 017720 "Contract Closeout."

### 3.2 REVIEW BY THE DEN PROJECT MANAGER

- A. One (1) electronic copy of the marked-up shop and working drawing and one (1) electronic copy of the product data will be returned to the Contractor by the DEN Project Manager. Only the transmittal form appropriately marked with the Action Code and comments, if any, will be returned on sample submittals.
- B. Contractor's responsibility for errors and omissions in submittals for compatibility will not be reduced, waived or otherwise limited by the review and acceptance of submittals by the DEN Project Manager.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **013325**

## **SECTION 013510 - CONSTRUCTION SAFETY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Work specified in this Section includes construction safety precautions and programs by the Contractor and the basis for reviews by the DEN Project Manager.
- B. For projects enrolled under DEN Rolling Owner Controlled Insurance Program (ROCIP) reference the Contract Special Conditions for all safety requirements.
- C. For projects enrolled under DEN Owner Controlled Insurance Program (OCIP) reference the Contract Special Conditions for all safety requirements.

#### **1.3 RESPONSIBILITY**

- A. The Contractor is responsible for the health and safety of the Contractor's personnel, agents, subcontractors and their personnel, and other persons on the worksite, for the protection and preservation of the Work and all materials and equipment to be incorporated therein, and for the worksite and the area surrounding the worksite. The Contractor shall take all necessary and reasonable precautions and actions to protect all such persons and property.
- B. This Section shall be interpreted in its broadest sense for the protection of persons and property by the Contractor and no action or omission by the DEN Project Manager or the DEN Project Manager's authorized representatives shall relieve the Contractor of any of its obligations and duties hereunder.

#### **1.4 SUBMITTALS**

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process. The Contractor's Site Specific Safety Plan shall be submitted and approved under the general Contract prior to commencing any Work. If a Task Order or Change Order is issued where the Work is not covered by the approved Contractor's Site Specific Safety Plan, then a revision to the Safety Plan specific for the Work in the Task Order shall be resubmitted for approval.

- 1. No progress payment shall be approved until the Contractor's Site Specific

Safety Plan has been accepted by the DEN Project Manager.

- B. The Contractor shall provide six (6) copies of the Contractor's Site Specific Safety Plan to the DEN Project Manager for review at least ten (10) calendar days before on-site construction begins. The Contractor's program must meet, as a minimum, all applicable federal, state and local government requirements, and the following:
1. The Contractor shall provide the following information for acceptance by the DEN Project Manager prior to the commencement of construction activities. The Site Specific Safety Plan must address all aspects listed below. If an item is not applicable, then this must be noted in the plan.
    - a. Name of the Contractor's safety representative.
    - b. If the Contractor is running multiple shifts or working more than (40) hours per week, the name of an assistant safety representative who can act in the absence of the site safety representative.
    - c. Twenty-four (24) hours per day emergency phone numbers of Contractor site management to be used in case of injury or accident. Provide at least four contacts.
    - d. Means of protecting employees working in trenches and excavations, including sloping and shielding.
      - 1) Soil classification will be considered as Type C when designing protective systems, unless the Contractor can prove to the satisfaction of DEN that the soil classification is otherwise. Soil classification change request shall be provided to the DEN Project Manager in writing. The decision of the DEN Project Manager will be provided to the Contractor in writing.
    - e. The Contractor shall show how material shall be stored beside the excavation. Stored material shall include the excavated and backfilled material
    - f. Injury and accident handling, including samples of the reporting form.
    - g. How personnel will be handled who are unable to safely perform their duties, including how the Contractor will determine whether personnel are unable to safely perform duties. This may include the Contractor's disciplinary process and employee's physical capabilities to perform the work safely.
    - h. How and when equipment will be checked to see that it is safe, that all safety guards are in place, and that the equipment is being used for its designed purpose and within its rated capacity.
    - i. How and when all electric devices will be checked for proper grounding and insulation. Describe the methods that will be used to lock out electric systems that should not be energized.
    - j. How trash and human organic waste will be disposed of.
    - k. How snow and ice will be removed by the Contractor in the project area.
    - l. How concrete forms will be anchored to ensure their stability, including calculations showing that the forms will safely hold the maximum construction loads.
    - m. How flammable materials will be stored and handled, and how any spills will

- be cleaned up and removed for disposal.
- n. What system will be used to prevent fires and, if fires do occur, who will be trained to fight them. In addition, what firefighting equipment will the Contractor have available and how will this equipment's condition be monitored.
  - o. How materials will be received, unloaded, stored, moved, and disposed of.
  - p. How personnel working above ground level will be protected from falling.
  - q. How people working beneath the construction work will be protected.
  - r. What will be done to protect personnel in case of severe weather.
  - s. How adequate lighting will be provided and monitored.
  - t. How air quality will be monitored to ensure that chemical exposures are below current, established OSHA Permissible Exposure Limits. How personnel will be protected if these limits are exceeded.
  - u. How the safety of work platforms, man lifts, material lifts, ladders, shoring, scaffolding, etc., will be ensured relating to load capacity and the protection of personnel using or working around them.
  - v. The type of personal protective equipment that will be used to protect personnel from hazards.
  - w. The type of safety training that will be provided to personnel to inform them of safe work procedures.
  - x. How daily audits and inspections will be performed to ensure compliance with the Contractor's Site Specific Safety Plan and current, applicable OSHA regulations.
  - y. Procedures to ensure that welding and other hot work is performed safely.
    - 1) A hot work permit from the Denver Fire Department (DFD) will be required for all welding, soldering, cutting, and brazing and or other processes required by DFD on the project. Contractor will comply with all of the provisions in the permit.
  - z. How compressed gases will be safely stored, handled, and used.
  - aa. Methods to ensure that personnel safely enter, work in, and exit confined spaces.
    - 1) All confined spaces on DEN property are considered permit required. A permit must be obtained from the DFD before Contractor personnel may enter a confined space. Contractors will comply with all provisions and requirements of this permit.
  - bb. How the hazards of chemicals will be communicated to personnel, including the use of material safety data sheets and chemical labels.
  - cc. Methods to ensure that forklifts and other powered industrial trucks are operated in a safe manner.
  - dd. How an effective hearing conservation program will be used to protect personnel from high noise levels and prevent hearing loss.
  - ee. How personnel will be protected from the effects of jet blast.
  - ff. How hazards will be identified and corrected when reported.

## 1.5 DEN PROJECT MANAGER'S REVIEW

- A. Prior to the start of any work by contractor or subcontractor personnel, the Contractor shall provide the DEN Project Manager with a list of its personnel, subcontractor's personnel and other personnel the Contractor has requested to work at Denver International Airport, who have signified in writing that they have been briefed on, or have read and understand, the Contractor's Site Specific Safety Plan.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 IMPLEMENT CONTRACTOR'S OPERATIONAL SAFETY PLAN

- A. Implement the approved Contractor's Operational Safety Plan as described in Article 1 of this Section and in Section 011100 "Summary of Work."
- B. If the Contractor experiences lost time or an injury rate greater than 75 percent of the national average for all construction, the Contractor shall notify the DEN Project Manager and audit its safety procedures and submit a plan to reduce its rates.
- C. If at any time the lost time or injury rates experienced by the Contractor are 150 percent or more of the national average for construction, the Contractor shall notify the DEN Project Manager and immediately hire an independent safety professional who shall audit the Contractor's procedures and operations and make a report of changes that the Contractor should implement to reduce the rate including changing personnel.
  - 1. The report shall be submitted to the DEN Project Manager.
  - 2. The Contractor shall immediately begin implementing the recommendations of the independent safety professional.
  - 3. A weekly report shall be submitted by the Contractor to the DEN Project Manager on the status of the implementation of the recommendations.
  - 4. Failure to comply with these requirements is a basis to withhold a portion of progress payments.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 013510

## SECTION 013516 - ALTERATION PROJECT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes special procedures for alteration work.

#### 1.3 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the DOR's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by DOR.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.



- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

#### 1.4 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
  - 1. Schedule construction operations in sequence required to obtain best Work results.
  - 2. Coordinate sequence of alteration work activities to accommodate the following:
    - a. Owner's continuing occupancy of portions of existing building.
    - b. Owner's partial occupancy of completed Work.
    - c. Other known work in progress.
    - d. Tests and inspections.
  - 3. Detail sequence of alteration work, with start and end dates.
  - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
  - 5. Use of elevator and stairs.
  - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheelbase dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project buildings and site. Some work is near circulation patterns [**and adjacent to restricted areas**] <Insert item of concern>. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. [**Access to restricted areas may not be obstructed.**] Plan and execute the Work accordingly.

#### 1.5 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Meeting for Alteration Work: Before starting alteration work, DEN Project Manager will conduct] meeting at Project site
  - 1. Attendees: In addition to representatives of City, DEN Project Manager, DOR, and Contractor, testing service representative, and specialists shall be represented at the meeting.
  - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:

- a. Alteration Work Sub-schedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
  - b. Fire-prevention plan.
  - c. Governing regulations.
  - d. Areas where existing construction is to remain and the required protection.
  - e. Hauling routes.
  - f. Sequence of alteration work operations.
  - g. Storage, protection, and accounting for salvaged and specially fabricated items.
  - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
  - i. Qualifications of personnel assigned to alteration work and assigned duties.
  - j. Requirements for extent and quality of work, tolerances, and required clearances.
  - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
3. Reporting: DEN Project Manager will record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from meeting.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at intervals appropriate for complexity of work. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation meeting.
1. Attendees: In addition to representatives of the City, DEN Project Manager, DOR, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at meeting shall be familiar with Project and authorized to conclude matters relating to alteration work.
  2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
    - a. Alteration Work Sub-schedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
    - b. Schedule Updating: Revise Contractor's Alteration Work Sub-schedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each entity present, including review

items listed in the "Preliminary Meeting for Alteration Work" Paragraph in this article and the following:

- 1) Interface requirements of alteration work with other Project Work.
  - 2) Status of submittals for alteration work.
  - 3) Access to alteration work locations.
  - 4) Effectiveness of fire-prevention plan.
  - 5) Quality and work standards of alteration work.
  - 6) Change Orders for alteration work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

#### 1.6 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to City that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain the City's property.
1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to location directed by DEN Project Manager.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Alteration Work Sub-schedule:
1. Submit alteration work sub-schedule within [seven] [7] days of date established for commencement of alteration work.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit 30 days before work begins.
- D. Fire-Prevention Plan: Submit 30 days before work begins.

#### 1.8 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of [five] 5 recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
    - a. Construct new mockups of required work whenever a supervisor is replaced.
  - B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
  - C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
    1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
    2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
  - D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with City's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
  - E. Safety and Health Standard: Comply with the current version of the ANSI/ASSE Safety and Health Program Requirements for Demolition Operations
- 1.9 STORAGE AND HANDLING OF SALVAGED MATERIALS
- A. Salvaged Materials:
    1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
    2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
    3. Store items in a secure area until delivery to specified location.
    4. Transport items to the designated storage area to be determined by the DEN Project Manager
    5. Protect items from damage during transport and storage.
  - B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
  2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by DOR, items may be dismantled and taken to an approved, suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
  2. Secure stored materials to protect from theft.
  3. Control humidity so that it does not exceed 85 percent. Maintain temperatures **5°F** or more above the dew point.
- E. Storage Space:
1. DEN Project Manager will arrange for limited on-site locations for free storage of salvaged material. This storage space may or may not include] security and climate control for stored material.
  2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.
- 1.10 FIELD CONDITIONS
- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings preconstruction photographs and preconstruction videotapes.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
- B. Discrepancies: Notify DEN Project Manager of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. DEN's Removals: Before beginning alteration work, verify in correspondence with DEN Project Manager that the following items have been removed:
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including

temporary protection.

## **PART 2 - PRODUCTS - (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 PROTECTION**

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
1. Use only proven protection methods, appropriate to each area and surface being protected.
  2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  3. Erect temporary barriers to form and maintain fire-egress routes.
  4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
  5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
  6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
  7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
  8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
  2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
1. Notify DEN Project Manager, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
  2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
  3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify DEN Project Manager immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
  - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
  - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
  
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection[ **as indicated on Drawings**].

### 3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
  - 1. Comply with NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations requirements unless otherwise indicated. Perform duties titled "City's Responsibility for Fire Protection."
  - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
    - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
  
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
  - 1. Obtain DFD approval for operations involving use of welding or other high-heat equipment Use of open-flame equipment is not permitted. Notify DEN Project Manager at least 72 hours before each occurrence, indicating location of such work.
  - 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
  - 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  - 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  - 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  - 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire

safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

- a. Train each fire watch in the proper operation of fire-control equipment and alarms.
  - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
  - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
  - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than **[30 minutes]** <Insert time> after conclusion of work[ **in each area**] to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
  - e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

### 3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off City's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.



### 3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation [**photographs**] [**or**] [**video recordings**]. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify DEN Project Manager of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
  - 1. Do not proceed with the work in question until directed by DEN Project Manager.

END OF SECTION **013516**

## **SECTION 013520 - CONSTRUCTION SAFETY - AIRSIDE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Work specified in this Section includes construction safety precautions and programs by the Contractor for airside, and the basis for reviews by the DEN Project Manager.
- B. Related Specification Sections:
  - 1. Section 011420 "Security Requirements and Sensitive Security Information".
  - 2. Section 011430 "Vehicle and Equipment Permitting".
  - 3. Section 011810 "Utilities Interface".
  - 4. Section 013510 "Construction Safety".
- C. For projects enrolled under DEN Rolling Owner Controlled Insurance Program (ROCIP) reference the Contract Special Conditions for all safety requirements.
- D. For projects enrolled under DEN Owner Controlled Insurance Program (OCIP) reference the Contract Special Conditions for all safety requirements.

#### **1.3 RESPONSIBILITY**

- A. The Contractor is responsible for the health and safety of the Contractor's personnel, agents, subcontractors and their personnel, and other persons on the worksite, for the protection and preservation of the Work and all materials and equipment to be incorporated therein, and for the worksite and the area surrounding the worksite. The Contractor shall take all necessary and reasonable precautions and actions to protect all such persons and property.
- B. This Section shall be interpreted in its broadest sense for the protection of persons and property by the Contractor and no action or omission by the DEN Project Manager or the DEN Project Manager's authorized representatives shall relieve the Contractor of any of its obligations and duties hereunder.

#### **1.4 SUBMITTALS**

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process. The

Contractor's Operational Safety Plan shall be submitted and approved under the general Contract prior to commencing any Work. If a Task Order or Change Order is issued where the Work is not covered by the approved Contractor's Operational Safety Plan, then a revision to the Safety Plan specific for the Work in the Task Order shall be resubmitted for approval.

1. No progress payment shall be approved until the Contractor's Operational Safety Plan has been accepted by the DEN Project Manager.

B. Scope: The Contractor's Operational Safety Plan shall be developed and submitted by the contractor for the DEN Project Manager's review and approval. The Operational Safety Plan shall be developed according to the guidelines and requirements provided in FAA AC No. 150/5370-2F "Operational Safety on Airports During Construction" and will describe how the Contractor will comply with the requirements of the Construction Safety and Phasing Plan (CSPP). The Operational Safety Plan shall cover the actions of not only the construction personnel and equipment, but the actions of inspection personnel and airport staff for the duration of construction activities.

C. Definitions:

1. Approach Surface: A surface longitudinally centered on the extended runway centerline and extending outward and upward from either a runway threshold or 200 feet behind a threshold. This surface is needed to define where unobstructed airspace above the runway begins.
2. Notice To Airmen (NOTAM): A notice to the flying public (airmen) through FAA's NOTAM system. Normally initiated by message to the nearest FAA Flight Service Station. Issuance of the NOTAM will be coordinated through the DEN Project Manager and DEN Operations.
3. Object Free Area: A two-dimensional ground area surrounding runways, taxiways, and taxi lanes that is clear of objects, except for objects whose location is fixed by function.
4. Safety Area (see AC 150/5300-13A): A defined surface adjacent to runways, taxiways and taxi lanes prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot or excursion from the paved surface. Each safety area must be cleared and graded and have no potentially hazardous ruts, humps, depressions or other surface variations. Each safety area must be drained by grading or storm sewers to prevent water accumulation. East safety area must be capable under dry conditions of supporting snow removal and aircraft rescue and firefighting equipment and or supporting the occasional passage of aircraft without causing any damage to the aircraft. No objects may be located in any safety area, except for objects that need to be located in a safety area because of their function. These objects must be constructed, to the extent practical, on frangibly mounted structures of the lowest practical height, with the frangible point no higher than three (3) inches above grade.

D. Policy: Aviation safety is a primary consideration during airport construction. These activities shall be planned and scheduled to minimize disruption of normal aircraft activities. If the clearances and restrictions described in this plan cannot be maintained while construction is underway, action will be taken by the Contractor to perform Work

at night or during periods of minimal aircraft activity.

E. Safety Impacts: The Contractor shall take all necessary steps and precautions to mitigate the impact of hazardous conditions as they may relate to the Work. Potentially hazardous conditions which may occur during airport construction include, but are not limited to, the following:

1. Trenches, holes, or excavations on or adjacent to any active runway, taxiway, taxi lane, apron, or related safety areas.
2. Unmarked/unlighted holes or excavations on or adjacent to any active runway, taxiway, taxi lane, apron, or related safety areas.
3. Mounds or piles of earth, construction material, temporary structures, or other objects on or in the vicinity of any active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
4. Pavement drop-offs that would cause, if crossed at normal operating speeds, damage to aircraft that normally use the airport. The maximum drop-off is 3 inches per FAA AC 150/5300-13A.
5. Vehicles or equipment (whether operating or idle) on any active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
6. Vehicles, equipment, excavations, stockpiles, or other materials that could impinge upon NAVAID-critical areas and degrade or otherwise interfere with electronic NAVAIDS or interfere with visual NAVAIDS facilities.
7. Unmarked utility, NAVAIDS, weather service, runway lighting, underground power, or signal cables that could be damaged during construction.
8. Objects or activities anywhere on or in the vicinity of an airport which would be distracting, confusing, or alarming to pilots during aircraft operations.
9. Unflagged/unlighted low visibility items such as tall cranes, backhoes, scrapers, dump trucks, rollers, compactors, dozers and the ilk, in the vicinity of an active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
10. Dirt, debris, or other transient accumulations that temporarily obscure pavement markings or pavement edges, or derogate the visibility of runway or taxiway markings or lighting or of construction and maintenance areas.
11. Trash or other materials with foreign object damage (FOD) potential, whether on runways, taxiways, taxi lanes, aprons or in related safety areas.
12. Failure to control vehicle, human and large animal access to, and nonessential nonaeronautical activities on, open aircraft movement areas.
13. Failure to maintain radio communication between construction vehicles and air traffic control or other on-field communications facilities.
14. Construction activities or material which could hamper Aircraft Rescue and Fire Fighting (ARFF) vehicle access from ARFF stations to all parts of the runway/taxiway system, runway approach and departure areas, or aircraft parking locations.
15. Inadequate fencing or other marking to separate construction areas from open aircraft operating areas.
16. Bird attractions such as edibles (food scraps, etc.), trees, brush, other trash, grass/crop seeding, or ponded water on or near the airport.

F. Safety Requirements:

1. General:

- a. During performance of this Contract, the airport runways, taxiways, taxi lanes, and aircraft parking aprons shall remain in use by aircraft to the maximum extent possible, consistent with continual safety. Aircraft use of areas near the Contractor's Work will be controlled to minimize disturbance to the Contractor's operation. However, AIRCRAFT HAVE THE RIGHT OF WAY AT ALL TIMES. The Contractor shall not allow employees, subcontractors, suppliers, or any unauthorized persons to enter or remain in any airport area that would be hazardous to persons or to aircraft operations.
  - b. Contractor personnel, airport staff and field inspectors directly involved in on-airport construction shall:
    - 1) Be aware of the types of conditions, safety problems, and/or hazards identified each day at the airport. To insure that all personnel are aware, daily meetings between management and supervisory personnel and their employees shall be scheduled prior to any work commencing on the shift.
    - 2) Inspect daily all work and/or storage areas for which the Contractor is responsible to be aware of current conditions.
    - 3) Promptly take all steps needed to remedy any unsafe or potentially unsafe condition. Coordinate with the DEN Project Manager to insure immediate corrective action is undertaken
  - c. Before commencement of construction activity the Contractor, through coordination with the DEN Project Manager and DEN Operations, shall give notice using the NOTAM system of construction on the airfield. In addition, a NOTAM shall be issued for the completion of construction on the airfield.
2. Construction Area Marking: Temporary lighting, barricades, flagging, and flashers are required as shown on the plans and per FAA AC 150/5370-2F Chapter 2 Section 220.b.(1)(2) Flag lines, traffic cones, flashers, edge lights, and/or signs shall be used as necessary:
- a. To clearly separate all construction from other parts of an air operations area
  - b. To identify isolated hazards, such as open manholes, excavations, areas under repair, stockpiled material, waste areas, etc.
  - c. Vehicle and pedestrian access routes used for airport construction shall be controlled to prevent any unauthorized entry of persons, vehicles, or animals.
  - d. Vehicle parking areas for Contractor employees shall be designated in advance to minimize traffic in open/active aircraft movement areas.
3. Cables and Utilities:
- a. Special attention shall be given to preventing unscheduled interruption of utility services and facilities. The location of all cables and utilities shall be identified prior to construction activities.
  - b. There shall be coordination among the Contractor, the DEN Project Manager, DEN Operations, the FAA, the National Weather Service, utility

- companies, and any other appropriate entity or organization. NAVAIDS, weather service facilities, electric cables, and other utilities must be fully protected during the entire construction time.
- c. Power, communication, and control cables leading to and from any FAA NAVAIDS, weather service, and other facilities will be marked in the field by the appropriate individuals as identified in Section 011810 "Utilities Interface" for the information of the Contractor before any work in their general vicinity is started. Thereafter, through the entire duration of construction, utilities shall be protected from any possible damage.
  - d. At the intersection of expansion joints and centerline lighting circuits on taxiways and runways, the electrical conduit may be within the 21" portion of the Portland cement concrete pavement. Coordination with the DEN Project Manager's representative and the DEN Electrical Department is of utmost importance for both the scheduling of an outage and the removal of conductors while cutting the joint.
4. Vehicle and Employee Identification:
- a. Contractor vehicles and equipment shall be flagged for high daytime visibility and if appropriate, lighted for nighttime operations. Vehicles that are not marked and lighted shall be escorted by a vehicle that is equipped with appropriate marking and lighting devices. Marking and lighting shall be in conformance with FAA AC 150/5210-5D, current edition, or as outlined in Section 011430 "Vehicle and Equipment Permitting" of the Contract Documents.
  - b. The Contractor will be required to conform to the specific requirements as outlined in Section 011420 "Security Requirements and Sensitive Security Information (SSI)" of the Contract documents.
5. Radio Communications:
- a. The Contractor's construction superintendent and flag personnel shall be required to coordinate directly with the DEN Project Manager or designated Representative. Only the DEN Project Manager or designated Representative shall monitor transceiver radios tuned to the frequency for communications with DEN Operations and B Tower Control. Radios shall be used to obtain the proper clearance concerning the movement of equipment, trucks, etc., on the airfield. Further, any unusual occurrences in the flight pattern of approaching or departing aircraft shall be acknowledged by all concerned so that operation of the airport and the construction work can be safely carried on at all times.
6. Haul Routes Crossing Active Aircraft Operation Areas:
- a. The Contractor shall provide a minimum of one (1) broom truck to continuously clean the surface of the active taxiway, taxi lane or apron of any foreign object damage (FOD) or other objectionable debris that may result from hauling activities. Additional broom trucks may be required to expedite the cleanup process. Opening the taxiway, taxi lane, or apron to aircraft operations shall only be approved after a visual inspection of the

- pavement surface by the DEN Airfield Operations Manager.
- b. The Contractor shall not work within the minimum of the following: 160 ft. of the centerline of an active taxiway, 310 ft. of the centerline of an active runway, or the minimum requirements of the FOD or Safety Zone unless otherwise noted in the Contract Documents and as approved in writing by the DEN Project Manager.
  - c. All construction equipment and vehicles shall be flagged for high daytime visibility and if appropriate, lighted for nighttime operations. Vehicles that are not marked and lighted shall be escorted by a vehicle that is equipped with appropriate marking and lighting devices. Marking and lighting shall be in conformance with FAA AC 150/5210-5D, current edition.
  - d. All Contractor and Subcontractor employees must be aware of the types of safety problems and hazards associated with aircraft operations and construction activities.

## PART 2 - PRODUCTS

### 2.1 Contractor's Operational Safety Plan

- A. The Contractor shall provide six (6) copies of the Contractor's Operational Safety Plan to the DEN Project Manager for review at least ten (10) calendar days before on-site construction begins. The Contractor's program must meet, as a minimum, all applicable federal, state and local government requirements, and the following:
  1. The Contractor shall provide the following information for acceptance by the DEN Project Manager prior to the commencement of construction activities. The Operational Safety Plan must address all aspects listed below. If an item is not applicable, then this must be noted in the plan.
    - a. Name of the Contractor's safety representative.
    - b. If the Contractor is running multiple shifts or working more than (40) hours per week, the name of an assistant safety representative who can act in the absence of the site safety representative.
    - c. Twenty-four (24) hours per day emergency phone numbers of Contractor site management to be used in case of injury or accident. Provide at least four contacts.
    - d. Means of protecting employees working in trenches and excavations, including sloping and shielding.
      - 1) Soil classification will be considered as Type C when designing protective systems, unless the Contractor can prove to the satisfaction of DEN that the soil classification is otherwise. Soil classification change request shall be provided to the DEN Project Manager in writing. The decision of the DEN Project Manager will be provided to the Contractor in writing.
    - e. The Contractor shall show how material shall be stored beside the excavation. Stored material shall include the excavated and backfilled

- material
- f. Injury and accident handling, including samples of the reporting form.
  - g. How personnel will be handled who are unable to safely perform their duties, including how the Contractor will determine whether personnel are unable to safely perform duties. This may include the Contractor's disciplinary process and employee's physical capabilities to perform the work safely.
  - h. How and when equipment will be checked to see that it is safe, that all safety guards are in place, and that the equipment is being used for its designed purpose and within its rated capacity.
  - i. How and when all electric devices will be checked for proper grounding and insulation. Describe the methods that will be used to lock out electric systems that should not be energized.
  - j. How trash and human organic waste will be disposed of.
  - k. How snow and ice will be removed by the Contractor in the project area.
  - l. How concrete forms will be anchored to ensure their stability, including calculations showing that the forms will safely hold the maximum construction loads.
  - m. How flammable materials will be stored and handled, and how any spills will be cleaned up and removed for disposal.
  - n. What system will be used to prevent fires and, if fires do occur, who will be trained to fight them. In addition, what firefighting equipment will the Contractor have available and how will this equipment's condition be monitored.
  - o. How materials will be received, unloaded, stored, moved, and disposed of.
  - p. How personnel working above ground level will be protected from falling.
  - q. How people working beneath the construction work will be protected.
  - r. What will be done to protect personnel in case of severe weather.
  - s. How adequate lighting will be provided and monitored.
  - t. How air quality will be monitored to ensure that chemical exposures are below current, established OSHA Permissible Exposure Limits. How personnel will be protected if these limits are exceeded.
  - u. How the safety of work platforms, man lifts, material lifts, ladders, shoring, scaffolding, etc., will be ensured relating to load capacity and the protection of personnel using or working around them.
  - v. The type of personal protective equipment that will be used to protect personnel from hazards.
  - w. The type of safety training that will be provided to personnel to inform them of safe work procedures.
  - x. How daily audits and inspections will be performed to ensure compliance with the Contractor's Operational Safety Plan and current, applicable OSHA regulations.
  - y. Procedures to ensure that welding and other hot work is performed safely.
    - 1) A hot work permit from the Denver Fire Department (DFD) will be required for all welding, soldering, cutting, and brazing and or other processes required by DFD on the project. Contractor will comply with all of the provisions in the permit.
  - z. How compressed gases will be safely stored, handled, and used.



- aa. Methods to ensure that personnel safely enter, work in, and exit confined spaces.
  - 1) All confined spaces on DEN property are considered permit required. A permit must be obtained from the DFD before Contractor personnel may enter a confined space. Contractors will comply with all provisions and requirements of this permit.
- bb. How the hazards of chemicals will be communicated to personnel, including the use of material safety data sheets and chemical labels.
- cc. Methods to ensure that forklifts and other powered industrial trucks are operated in a safe manner.
- dd. How an effective hearing conservation program will be used to protect personnel from high noise levels and prevent hearing loss.
- ee. How personnel will be protected from the effects of jet blast.
- ff. How hazards will be identified and corrected when reported.

## 2.2 DEN PROJECT MANAGER'S REVIEW

- A. Prior to the start of any work by contractor or subcontractor personnel, the Contractor shall provide the DEN Project Manager with a list of its personnel, subcontractor's personnel and other personnel the Contractor has requested to work at Denver International Airport, who have signified in writing that they have been briefed on, or have read and understand, the Contractor's Operational Safety Plan.

## PART 3 - EXECUTION

### 3.1 IMPLEMENT CONTRACTOR'S OPERATIONAL SAFETY PLAN

- A. Implement the approved Contractor's Operational Safety Plan as described in Part 1 and Part 2 of this Section and in Section 011100 "Summary of Work."
- B. If the Contractor experiences lost time or an injury rate greater than 75 percent of the national average for all construction, the Contractor shall notify the DEN Project Manager, audit its safety procedures, and submit a plan to reduce its rates.
- C. If at any time the lost time or injury rates experienced by the Contractor are 150 percent or more of the national average for construction, the Contractor shall notify the DEN Project Manager and immediately hire an independent safety professional who shall audit the Contractor's procedures and operations and make a report of changes that the Contractor should implement to reduce the rate including changing personnel.
  - 1. The report shall be submitted to the DEN Project Manager.
  - 2. The Contractor shall immediately begin implementing the recommendations of the independent safety professional.
  - 3. A weekly report shall be submitted by the Contractor to the DEN Project Manager on the status of the implementation of the recommendations.
  - 4. Failure to comply with these requirements is a basis to withhold a portion of

progress payments.

3.2 ROLLING OWNER CONTROLLED INSURANCE PROGRAM (ROCIP)

- A. Implement Rolling Owner Controlled Insurance Program (ROCIP) as provided in the Project Manual issued for bid or proposal

3.3 OWNER CONTROLLED INSURANCE PROGRAM (OCIP)

- A. Implement Owner Controlled Insurance Program (OCIP) as provided in the Project Manual issued for bid or proposal

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **013520**

## SECTION 014100 - REGULATORY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section identifies primary compliance with the State, City and County of Denver's regulatory requirements including:
  - 1. City and County of Denver / Department of Aviation.
  - 2. Colorado Department of Public Health and Environment.
  - 3. City and County of Denver Development Services, including the Department of Public Works and Division of Wastewater Management.
  - 4. The standards that govern design and construction projects at Denver International Airport.
- B. Construction shall be based on the latest edition of the referenced codes including additions and revisions thereto that are in effect at the time of Project bidding or Task Order pricing or GMP established whichever is latest, and as specifically related.

#### 1.3 RELATED SECTIONS

- A. Section 015719 "Temporary Environmental Controls" for environmental and related permitting requirements.

#### 1.4 BUILDING CODE

- A. All design and construction work shall be governed by the Building Code for the City and County of Denver, latest edition. This is based upon the International Building Code of the International Code Council with Denver Amendments to this code. Appendix N of the Denver Amendments addresses Construction of Airport Buildings and Structures.
  - 1. This Contract shall be based on the most current published version of the ICC series as Amended by The City and County of Denver.

#### 1.5 DENVER BUILDING DEPARTMENT

- A. For review and approval of all construction documents for compliance to the Denver

building code:

## 1.6 DENVER FIRE DEPARTMENT

- A. For review and approval of plans for compliance with the Denver Fire Department's requirements as they apply to the Denver International Airport:

Denver Fire Department  
745 West Colfax Avenue  
Denver, Colorado 80204  
Telephone 720-913-3474

- B. The Contractor is advised that the Denver Fire Department – Fire Prevention Bureau requires permitting for the following activities as they apply to the scope of work. The Contractor is responsible for obtaining the appropriate permits necessary to complete the work. All costs associated with this permitting and policy compliance shall be the responsibility of the Contractor. The policies all reference the International Fire Code (IFC).

1. “?Hot work”, which is defined as the operation of any equipment or tool that creates sparks, hot slag, or radiant or convective heat as a result of the work. This includes, but is not limited to, welding, cutting, brazing, or soldering.
2. Use and storage of compressed gas for both temporary storage and permanent facility installation. This includes, but is not limited to, flammable gas (excluding propane-LPG), oxidizer (including oxygen), and inert and/or simple asphyxiates.
3. Tank installation, which includes aboveground storage tanks (AST) and underground storage tanks (UST) for both temporary tanks and permanent facility installations.

- C. In addition to the above permits, the Denver Fire Department may require other permits that are associated with the specific work in the Contract Documents. Policies provided by the Denver Fire Department are meant to provide basic information for the most common conditions and situations. In any given occupancy, many other Uniform Fire Code requirements may be enforced. These should be addressed with the Denver Fire Department before construction begins and during construction with premise inspection(s).

1. The Fire Prevention Bureau web site is [denfpb@denvergov.org](mailto:denfpb@denvergov.org)

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PERMITS AND CERTIFICATIONS

- A. The Contractor shall maintain records on site of all permits acquired by federal, state, and local agencies. Posting of permits shall conform to requirements of the respective agencies.

- B. At the completion of any inspection by other agencies, the Contractor shall forward copies of the status of the inspection and copies of any approved or "signed-off" inspections by the respective agencies to the DEN Project Manager.
- C. At the time of request for Substantial Completion, the Contractor shall forward to the DEN Project Manager all permits approved by the respective agencies.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION **014100**

## SECTION 014210 - REFERENCED MATERIAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 REFERENCED MATERIAL

- A. City and County of Denver, Department of Aviation, Standard Specification for Construction, General Contract Conditions
- B. The following documents may be available for examination at the Owner's offices unless otherwise noted. The referenced material and documents are not part of the Contract Documents unless otherwise specified.

- 1. Environmental Impact Statement (EIS).
- 2. Geotechnical Reports:
  - a. Borings, other field and laboratory explorations, and investigations have been made to indicate subsurface materials at particular locations. Explorations and investigations conducted by designers and their subconsultants are solely for the purpose of study and design.
  - b. The subsurface exploration and investigation information is presented or made available to indicate some of the conditions that may be encountered during construction and is offered as supplementary information only. Geotechnical information presented in the referenced material represents the opinion of soils consultants as to the character of the materials encountered. Subsurface information was directly obtained only at the specified location and necessarily indicates subsurface conditions only at the respective plan location, depths penetrated and only at the time of the exploration.
  - c. Neither the City nor the Designers assume any responsibility whatever in respect to the sufficiency or accuracy of borings made, or of the logs of test borings, or of other investigations, or of the interpretations made thereof, and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations are representative of those existing throughout such area, or any part thereof, or that unforeseen developments may not occur. It is expressly understood that the making of deductions, interpretations, and conclusions from all of the accessible factual information, including the nature of the materials to be excavated, the difficulties of doing other work affected by the geology, groundwater elevations and other subsurface conditions at the site of the Work are the Contractor's sole responsibility.

- d. Information derived from inspection of logs of borings, topographic maps, technical memorandum, reports, or plans showing information of the subsurface of site conditions will not relieve the Contractor from any risk or from properly examining the site and making such additional investigations as the Contractor may elect or from properly fulfilling all the terms of the Contract Documents.
3. Available Conceptual Utility and Drainage Reports.
4. DEN Building Information Modeling (BIM) Design Standards Manual (DSM)
5. Woolpert, Inc. Report - "A Low Distortion Projection for Denver International Airport (DEN)", dated 12/10/2010.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION (Not Used)**

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

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

**END OF SECTION 014210**

## SECTION 014220 - ABBREVIATIONS AND SYMBOLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 REFERENCE LIST

- A. Documents published by the following agencies may be referenced within these Contract Documents to define the quality of materials, equipment, workmanship, and other features of Work. Unless otherwise stated, the reference documents shall be of the latest edition as of the date of the Advertisement for Bids.
- B. Wherever used in the Contract Documents, the following abbreviations will have the meanings listed:

| Abbreviation | Definition                                                         |
|--------------|--------------------------------------------------------------------|
| AALA         | American Association of Laboratory Accreditation                   |
| AAN          | American Association of Nurserymen                                 |
| AAO          | Affirmative Action Officer                                         |
| AASHTO       | American Association of State Highway and Transportation Officials |
| ACI          | American Concrete Institute                                        |
| ADA          | Americans with Disabilities Act                                    |
| AFI          | Air-Filter Institute                                               |
| AGTS         | Automated Ground Transportation System                             |
| AIA          | American Institute of Architects                                   |
| AISC         | American Institute of Steel Construction                           |
| AISI         | American Iron and Steel Institute                                  |
| AITC         | American Institute of Timber Construction                          |
| AMCA         | Air Moving and Conditioning Association                            |
| ANSI         | American National Standards Institute, Inc.                        |
| APA          | American Plywood Association                                       |
| APEN         | Air Pollution Emission Notes                                       |
| APWA         | American Public Works Association                                  |
| ARI          | Air Conditioning and Refrigeration Institute                       |
| ASCE         | American Society of Civil Engineers                                |



| <b>Abbreviation</b> | <b>Definition</b>                                                          |
|---------------------|----------------------------------------------------------------------------|
| ASHRAE              | American Society of Heating, Refrigeration, and Air Conditioning Engineers |
| ASME                | American Society of Mechanical Engineers                                   |
| ASNT                | American Society for Non-Destructive Testing                               |
| ASPE                | American Society of Plumbing Engineers                                     |
| ASSE                | American Society of Sanitary Engineering                                   |
| ASTM                | American Society for Testing and Materials                                 |
| AWPA                | American Wood Preserver's Association                                      |
| AWS                 | American Welding Society                                                   |
| AWWA                | American Water Works Association                                           |
| BID                 | Building Inspection Division, Department of Public Works                   |
| BIM                 | Building Information Modeling                                              |
| CAR                 | Corrective Action Report                                                   |
| CCD                 | City and County of Denver                                                  |
| CCR                 | Contractor Change Request                                                  |
| CCRL                | Cement Concrete Reference Laboratory                                       |
| CD                  | Change Directive                                                           |
| CDOH                | Colorado Department of Highways or Colorado Department of Health           |
| CDOT                | Colorado Department of Transportation                                      |
| CMEC                | Concrete Materials Engineering Council                                     |
| CN                  | Change Notice                                                              |
| CO                  | Change Order                                                               |
| COE                 | Corps of Engineers                                                         |
| CPM                 | Critical Path Method                                                       |
| CR                  | Change Request                                                             |
| CRSI                | Concrete Reinforcing Steel Institute                                       |
| CSI                 | Construction Specifications Institute                                      |
| DEN                 | Denver International Airport                                               |
| DFD                 | Denver Fire Department                                                     |
| DOT                 | United States Department of Transportation                                 |
| DOR                 | Designer of Record                                                         |
| DWB                 | Denver Water Board                                                         |
| EEO                 | Equal Employment Officer or Equal Employment Opportunity                   |
| EIA                 | Electronics Industry Association                                           |
| EIS                 | Environmental Impact Statement                                             |
| EPA                 | Environmental Protection Agency                                            |
| FAA                 | Federal Aviation Administration                                            |

| <b>Abbreviation</b> | <b>Definition</b>                                                                        |
|---------------------|------------------------------------------------------------------------------------------|
| FCC                 | Federal Communications Commission                                                        |
| FHWA                | Federal Highway Administration                                                           |
| FM                  | Factory Mutual Association                                                               |
| FS                  | Federal Specifications (U.S. General Services Administration)                            |
| GCC                 | General Contract Conditions                                                              |
| GIS                 | Geographic Information Systems                                                           |
| GMP -               | Guaranteed Maximum Price                                                                 |
| IAPMO               | International Association of Plumbing and Mechanical Officials                           |
| IBC                 | International Building Code (published by ICC)                                           |
| IBR                 | Institute of Boiler and Radiator Manufacturer's                                          |
| ICBO                | International Conference of Building Officials                                           |
| ICC                 | International Code Council                                                               |
| ICEA                | Insulated Cable Engineers Association                                                    |
| IEEE                | Institute of Electrical and Electronic Engineers                                         |
| IES                 | Illuminating Engineering Society                                                         |
| IMC                 | International Mechanical Code (published by ICBO)                                        |
| IPC                 | International Plumbing Code (published by ICBO)                                          |
| ISA                 | Instrument Society of America                                                            |
| ITA                 | Independent Testing Agency                                                               |
| MIL                 | Military Specifications (Naval Publications and Forms Center)                            |
| MSS                 | Manufacturers Standardization Society of the Valve and Fittings Industry                 |
| MUTCD               | Manual of Uniform Traffic Control Devices                                                |
| NAAB                | National Association of Air Balance                                                      |
| NACE                | National Association of Corrosion Engineers                                              |
| NBS                 | National Bureau of Standards (now called National Institute of Standards and Technology) |
| NEC                 | National Electric Code (NFPA 70)                                                         |
| NECA                | National Electric Contractors Association                                                |
| NEMA                | National Electrical Manufacturer's Association                                           |
| NESC                | National Electrical Safety Code                                                          |
| NFC                 | National Fire Code (as published by NFPA)                                                |
| NFPA                | National Fire Protection Association                                                     |
| NICET               | National Institute for the Certification of Engineering Technologies                     |
| NIST                | National Institute of Standards and Technology                                           |
| NGS                 | National Geological Survey                                                               |
| NLMA                | National Lumber Manufacturers Association                                                |
| NOAA                | National Oceanic and Atmospheric Administration                                          |

| <b>Abbreviation</b> | <b>Definition</b>                                                  |
|---------------------|--------------------------------------------------------------------|
| NRMCA               | National Ready Mix Concrete Association                            |
| NTP                 | Notice to Proceed                                                  |
| NVLAP               | National Voluntary Laboratory Accreditation Program                |
| OSHA                | Occupational Safety and Health Administration                      |
| PCA                 | Portland Cement Association                                        |
| PCI                 | Prestressed Concrete Institute                                     |
| PDM                 | Precedent Diagram Method                                           |
| PS                  | Product Standard of NIST (U.S. Department of Commerce)             |
| PM                  | Project Manager                                                    |
| PMT                 | Project Management Team                                            |
| PXP                 | Project Execution Plan                                             |
| QA                  | Quality Assurance                                                  |
| QC                  | Quality Control                                                    |
| RFI                 | Request for Information                                            |
| RTD                 | Regional Transportation District                                   |
| SC                  | Special Contract Condition                                         |
| SDI                 | Steel Door Institute                                               |
| SMACNA              | Sheet Metal and Air Conditioning Contractor's National Association |
| SSPWC               | Standard Specifications for Public Works Construction              |
| TCP                 | Traffic Control Plan                                               |
| TSA                 | Transportation Security Administration                             |
| UL                  | Underwriters Laboratories, Inc.                                    |
| USC                 | United States Code                                                 |
| WBS                 | Work Breakdown Schedule                                            |

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION (Not Used)**

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **014220**

## SECTION 014225 - REFERENCE STANDARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section contains a summary of industry-accepted and recognized standards published by trade associations, government, and institutional organizations that are referred to in the various Sections of these specifications or elsewhere in the Contract Documents.
- B. Standards listed herein are included in the Contract Documents by this reference and become a part of the Contract Documents to the same extent as though included in their entirety unless specific limitations are noted in the individual specifications Sections.
- C. Listings of reference standards include name and address of the organization publishing the standard, and the full name and designator of each of the standards referenced herein.
- D. If a publication date or edition number is listed with the reference standard, that publication date or edition number shall apply. Otherwise, the publication date or edition number in effect at the Contract date shall apply.
- E. Inclusion of reference standards herein does not make the DEN Project Manager an agent of the publishing agency, nor does it obligate the DEN Project Manager to perform inspections required by or to enforce rules or regulations contained in the reference standards.

#### 1.3 SCHEDULE OF REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, NW, Suite 249, Washington, DC 20090:
  - 1. AASHTO M 36–Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
  - 2. AASHTO M216–Standard Specification for Lime for Soil Stabilization.
  - 3. AASHTO T26–Standard Method of Test for Water to be Used in Concrete.
  - 4. AASHTO T84–Specific Gravity and Absorption of Fine Aggregate.
  - 5. AASHTO T85–Specific Gravity and Absorption of Coarse Aggregate.
  - 6. AASHTO T103–Soundness of Aggregates by Freezing and Thawing
  - 7. AASHTO T219–Standard Methods of Testing Lime for Chemical Constituents

and Particle Sizes.

- B. American Concrete Institute (ACI) 38800 Country Club Drive, Farmington Hills, MI 48331
1. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  2. ACI 301—Specifications for Structural Concrete for Buildings.
  3. ACI 304—Recommended Practices for Measuring, Mixing, Transporting and Placing Concrete.
  4. ACI 304.2R—Placing Concrete by Pumping Methods.
  5. ACI 305R—Hot Weather Concreting.
  6. ACI 306R—Cold Weather Concreting.
  7. ACI 318—Building Codes Requirements for Structural Concrete
    - a. Reference to ACI 318 may be limited to more stringent requirements of local building code.
- C. American Society for Testing and Materials (ASTM), International 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428:
1. ASTM A 27—Mild to Medium Strength Carbon - Steel Casting for General Application.
  2. ASTM A 36—Structural Steel.
  3. ASTM A 47—Malleable Iron Castings.
  4. ASTM A 82—Specification for Steel Wire, Plain, for Concrete Reinforcement: Replaced by A1064
  5. ASTM A 123—Hot-dip Galvanizing.
  6. ASTM A 184—Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  7. ASTM A 185—Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement: Replaced by A1064
  8. ASTM A 283—Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
  9. ASTM A 615—Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  10. ASTM A 706—Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
  11. ASTM C 25—Method for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime.
  12. ASTM C29—Unit Weight and Voids in Aggregate
  13. ASTM C 31—Methods of Making and Curing Concrete Test Specimens in the Field.
  14. ASTM C 33—Specification for Concrete Aggregates.
  15. ASTM C 39—Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  16. ASTM C 42—Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  17. ASTM C 76—Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  18. ASTM C 88—Soundness of Aggregates by Use of Sodium Sulfate or Magnesium

Sulfate.

19. ASTM C 94—Specification for Ready Mixed Concrete.
20. ASTM C 109—Compressive Strength of Hydraulic Cement Mortars
21. ASTM C 110—Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone.
22. ASTM C 117—Materials Finer than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing.
23. ASTM C 131—Resistance of Abrasions of Small Size Coarse Aggregate by Use of the Los Angeles Machine.
24. ASTM C 136—Method for Sieve Analysis of Fine and Coarse Aggregates.
25. ASTM C 138—Unit Weight, Yield, and Air Content of Concrete.
26. ASTM C 143—Test Method for Slump of Hydraulic – Cement Concrete
27. ASTM C 150—Specification for Portland Cement
28. ASTM C 171—Specification for Sheet Material for Curing Concrete.
29. ASTM C 172—Method of Sampling Fresh Concrete.
30. ASTM C 173—Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
31. ASTM C 231—Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
32. ASTM C 260—Specification for Air Entraining Admixture for Concrete.
33. ASTM C 309—Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
34. ASTM C 443—Joints for Concrete Pipe and Manholes, using Rubber Gasket
35. ASTM C 494—Specification for Chemical Admixtures for Concrete.
36. ASTM C 595—Blend Hydraulic Cements.
37. ASTM C 618—Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete
38. ASTM C 655—Reinforced Concrete D Load Culvert, Storm Drain, and Sewer Pipe.
39. ASTM C 789—Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers: Replaced by C1433
40. ASTM C 803—Test Method for Penetration Resistance of Hardened Concrete.
41. ASTM C 805—Test Method for Rebound Number of Hardened Concrete.
42. ASTM C 977—Specification for Quicklime and Hydrated Lime for Soil Stabilization.
43. ASTM D 75—Sampling Aggregate.
44. ASTM D 422—Test Method for Particle Size Analysis of Soils.
45. ASTM D 516-88—Standard Test Method for Sulfate Ions in Water.
46. ASTM D 693—Crushed Stone, Crushed Slag and Crushed Gravel for Dryer Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements: Withdrawn
47. ASTM D 698—Laboratory Compaction Characteristics of Soil using Standard Effort
48. ASTM D 751—Test Method for Coated Fabrics
49. ASTM D 1556—Test Method for Density of Soil in Place by the Sand-Cone Method.
50. ASTM D 1557—Laboratory Compaction Characteristics of Soil using Modified Effort
51. ASTM D 1682—Ultraviolet Resistance Grab Tensile Strength Grab Tensile Elongation Toughness: Replaced by D5034 and D5035

52. ASTM D 1751—Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
  53. ASTM D 1752—Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
  54. ASTM D 2167—Test Method for Density of Soil in Place by the Rubber-Balloon Method.
  55. ASTM D 2216—Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.
  56. ASTM D -79 (2011) Hydroxypropyl Methylcellulose
  57. ASTM D 2419—Sand Equivalent Value of Soils and Fine Aggregate.
  58. ASTM D 2487—Test Method for Classification of Soils for Engineering Purposes.
  59. ASTM D 2922—Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Method: Replaced by D6938
  60. ASTM D 3017—Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth): Replaced by D6938
  61. ASTM D 3665—Random Sampling of Paving Materials.
  62. ASTM D 4253—Test Method for Maximum Index Density of Soils Using Vibratory Table.
  63. ASTM D 4318—Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  64. ASTM D 4397—Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications.
  65. ASTM D 4546—Test Method for One-Dimensional Swell or Settlement Potential of Cohesive Soils.
  66. ASTM E 329—Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
  67. ASTM F 477—Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  68. ASTM F 758—Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport and Similar Drainage.
- D. American Welding Society (AWS), 550 NW LeJeune Road, Miami, FL 33135 AWS Code for Welding in Building Construction (Structural Welding Code).
- E. Concrete Reinforcing Steel Institute (CRSI) 933 N. Plum Grove Road, Schaumburg, IL 60195, (312) 490-1700:
1. Manual of Standard Practice.
- F. Colorado Department of Transportation (CDOT) Division of Administration, Office of Bid Plans, 4201 E. Arkansas Avenue, Denver, CO 80222:
1. Standard Specifications for Road and Bridge Construction (latest edition) Colorado Standard Plans, M&S Standards.
- G. Federal Highway Administration (FHWA) Superintendent of Documents, US Government Printing Office, Washington DC, 20402:
1. Manual of Uniform Traffic Control Devices (latest edition).



**PART 2 - PRODUCTS (Not used)**

**PART 3 - EXECUTION (Not used)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **014225**

## SECTION 014230 - DEFINITIONS AND CONVENTIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section contains a list of definitions of words or phrases and grammatical or contextual conventions commonly used in these Contract Documents.

#### 1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Alphabetical Listing of Definitions:
  - 1. **As indicated:** Shown on the drawings by graphic indication, notes, or schedules, or written in the specifications or elsewhere in the Contract Documents.
  - 2. **As directed, as approved, as requested:** Unless otherwise indicated, these terms imply "by the DEN Project Manager" and require that an instruction be obtained by the Contractor from the DEN Project Manager.
  - 3. **Concealed:** Embedded in masonry, concrete, or other construction; installed in furred spaces; within double partitions or hung ceilings; in trenches; in crawl spaces or in enclosures.
  - 4. **Ensure:** To make certain in a way that eliminates the possibility of error.
  - 5. **Exposed:** Not installed underground or "concealed" as defined above.
  - 6. **Furnish or Provide:** To supply, install and connect complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
  - 7. **Indicated, Shown, or Noted:** As depicted on drawings or specifications.
  - 8. **Install:** To erect, mount and connect complete with related accessories.
  - 9. **Or equal, or approved equal:** Refers to products which, in the opinion of the DEN Project Manager, are similar in all respects to products specified by proprietary brand name. Refer to Section 012510 "Substitutions" for procedures for submittal of proposed substitutions.
  - 10. **Rework:** To repair existing items or work required to be removed and replaced in order to accomplish the Work in accordance with the Contract Documents.
  - 11. **Related Work:** Includes, but not necessarily limited to, mentioned work associated with, or affected by, the Work specified.
  - 12. **Reviewed, Satisfactory, Accepted, or Directed:** Assumes by or to the DEN Project Manager.
  - 13. **Similar, or Equal:** Same in materials, weight, size, design, construction, capacity, performance, and efficiency of specified product.

14. **Supply:** To purchase, procure, acquire and deliver complete with related accessories.
15. **Unless Otherwise Indicated and Unless Otherwise Noted:** General note to perform work as indicated or shown on drawings or in specifications unless specifically directed otherwise elsewhere in the Contract Documents; may be abbreviated "U.O.N.", "U.O.I.", or "U.N.O."

C. BIM Model Definitions:

1. **Building Information Model (BIM):** BIM is a digital representation of the physical and functional characteristics of the Project and is referred as a Model(s), which term may be used to describe a Model Element, a single Model or technology used to create the Model.
2. **Design Model:** A Model that has reached the stage of completion that would customarily be expressed by an architect or engineer in two-dimensional Construction Documents.
3. **Construction Model:** The equivalent of shop drawing and other information useful to construction. A model that consists of data imported from a "Design Model or", if none exist, from a designer's "Construction Document".
4. **Federated Model:** Distinct component models "linked" together in such a manner that the linked data sources so not lose the indent or integrity by being so linked.
5. **Level of Development (LOD):** LoD describes the level of completeness to which a Model Element is developed.
6. **Model Element:** Is a portion of the BIM representing a component system or assembly within a building or building site.
7. **Model Element Author:** The party responsible for developing the content of a specific Model Element to the LoD for a particular phase of the Project.

1.4 BIM REFERENCE STANDARDS

- A. Refer to the DEN BIM Design Standard Manual (DSM) for the proposed minimum requirements of the BIM Execution Plan. The execution plan shall be further developed jointly with DEN and the Contractor to specifically address the administrative steps necessary to provide comprehensive BIM system before during and after construction.

1.5 CONVENTIONS

A. Specifications Format:

1. In order to standardize the location of information in the Contract Documents, the specifications generally are organized in one or more of the following formats:
  - a. The "MASTERFORMAT" 2011 Edition published by the Construction Specifications Institute.
  - b. The Standard Specifications for Road and Bridge Construction published by CDOT.
  - c. The alphanumeric system as published by the FAA.

B. Organization of Drawings and Specifications:

1. Organization of the specifications into divisions and sections, and arrangement or numbering of drawings is intended solely for the convenience of the Contractor in the Contractor's responsibilities to divide the Work among subcontractors or to establish the extent of work to be performed by any trade.
2. Neither the City nor the DEN Project Manager assume any liability arising out of jurisdictional issues or claims advanced by trade organizations or other interested parties based on the arrangement or organization of drawings or specifications.

C. Gender and Number:

1. For convenience and uniformity, parties to the Contract, including the City, Contractor, and DEN Project Manager, and their subcontractors, suppliers, installers, consultants or other interested parties are referred to throughout the Contract Documents as if masculine in gender and singular in number. Such reference is not intended to limit the meaning of the Contract Documents to the masculine gender or singular number.

D. Singular vs. Plural:

1. Materials, products, equipment, or other items of work referred to in the singular shall be construed as plural where applicable by the intent of the Contract Documents and shall not limit quantities to be provided by the Contractor.

E. Imperative Mood:

1. Specifications and notes on the drawings or elsewhere in the Contract Documents are generally written in the imperative mood as instructions to the Contractor, whether the Contractor is specifically addressed or not.

F. References to Subcontractors or Trades

1. References to subcontractors, trades or other entities, which are not parties to the Contract, shall be construed as meaning the Contractor whose responsibility it shall be to divide the Work among subcontractors or trades. Such references are used as a matter of convention, and are not intended to preclude or direct the Contractor's responsibility to divide the Work.

G. Abbreviations

1. A list of abbreviations used in the Contract Documents is included in Technical Specifications Section 014220 "Abbreviations and Symbols"; an abridged list of abbreviations used on the drawings is included with the drawings.
2. Abbreviations are believed to be those in general use in the construction industry. Contact the DEN Project Manager for clarification of abbreviations for which the meaning is not clear.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **014230**

## **SECTION 014310 -DEN QUALITY ASSURANCE**

Per the DEN Technical Specification Committee, this section is deleted from the DEN Technical Specification Library.

This Section has no Section Text.

**PART 1 - GENERAL (Not Applicable)**

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 014310**

## SECTION 014320 - DEN QUALITY ASSURANCE FOR FAA FUNDED PROJECTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Title 17 – Inspection and Defects in the General Contract Conditions, 2011 Edition.
- C. ASTM standard practices and specifications testing including, but not limited to, the following:
  - 1. ASTM C 1077: Standard Practices for Laboratory Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
  - 2. ASTM D 3666: Road & Paving Materials
  - 3. ASTM D 3740: Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
  - 4. ASTM E 329: Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction
  - 5. ASTM E 543: Determining the Qualifications of Nondestructive Testing Agencies.
- D. Other:
  - 1. Standard testing practices for other disciplines.

#### 1.2 SUMMARY

- A. This Section identifies Denver International Airport (DEN) inspection activities to be performed by inspectors employed by DEN and working under the direction of the DEN Project Manager.

#### 1.3 QUALITY ASSURANCE

- A. Inspection and tests, conducted by persons or agencies other than the Contractor, shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet all requirements of Contract Documents and the referenced standards.
- B. The inspection and approval of Work by other agencies above does not constitute inspection or acceptance of Work required by DEN. The Contract Documents may contain requirements more stringent than Denver Building Inspection Division or other code agency requirements. The City will perform all acceptance testing.

- C. The Contractor will employ the services of a Material Testing Agency in conformance with Section 014525 "Material Testing Agency" to perform acceptance testing on all earthwork and earthwork related work items. DEN Quality Assurance (QA) program will monitor all tests performed by the Contractor's Material Testing Agency and must be present on site during all acceptance testing and inspections.
- D. The City will employ the services of a Testing Agency (TA), which will perform all acceptance testing.
- E. Laboratory and field testing requirements to be conducted by the TA for materials and construction on this project are included in the appropriate Contract Documents. Where the Contract Documents reference the CDOT Standard Specifications for Road and Bridge Construction, the references shall also mean CDOT Field Materials Manual for schedule of tests unless otherwise stated. As a minimum, the TA described in this Section shall perform all applicable tests including the sampling and acceptance testing. In the event of such a conflict between the schedule and a specification in the Contract Documents, the more comprehensive testing shall govern unless otherwise noted.
- F. Inspections and tests conducted by the TA shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet the requirements of all Contract Documents and referenced standards. Employment of the City's TA does not relieve the Contractor of providing the required Quality Control program.
- G. When inspections or tests by the TA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor.
- H. Samples will only be considered if taken at random.
- I. The Contractor is obligated to correct any item deemed deficient at no additional cost to the City.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION (Not Used)**

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**



5.1 METHOD OF PAYMENT

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

END OF SECTION 014320

## SECTION 014510 - CONTRACTOR QUALITY CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section identifies the Quality Control activities to be performed during all phases of the Contract by the Contractor.
- B. The Contractor shall have in place a Quality Control Program as necessary to ensure that all materials and work are completed in compliance with Contract Documents. The Contractor is solely responsible for Quality Control and shall provide the necessary quality control personnel to assure that all materials, workmanship, and tests are in conformance with the Project documents with the exception of those tests and/or audits that may be conducted by the City as defined in the contract documents.
- C. Test schedules and/or testing requirements for materials used on this project are included in the technical specifications. Laboratory and field-testing identified in the specifications shall be conducted by a Testing Agency retained by the Contractor; hereafter is referred to as the Contractor Testing Agency (CTA).
- D. The City or its consultant working as the City agent will employ a testing agency to perform all the required Quality Assurance and Special Inspection Testing of material and Inspection of workmanship required by the Contract Documents and the Building Official to fulfill the code and the regulatory authority's requirements. The Contractor must schedule these tests and provide access to the City agents' inspectors and testers to perform these tests and inspections. The performance of the tests by the City does not relieve the Contractor of the responsibility to deliver a fully functional building meeting all the requirements of the Contract Documents and their intent. The Contractor must develop its own testing program for processing, acceptance from the subcontractor or suppliers at a frequency defined by the contractor for its own process control and to assure delivery of the intended acceptable workmanship. All time impacts of testing and retesting shall be accounted for in the updated schedule and any mitigation of time impacts shall be the responsibility of the Contractor.

#### 1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittals" and Section 013325 "Submittal Procedures" for submittal requirements.
- B. Quality Control Plan: Within ten (10) days after Notice to Proceed, the Contractor shall

submit a Quality Control Plan for review and acceptance. The Quality Control Plan shall be accepted by the DEN Project Manager prior to any Work or materials being incorporated into the Project. Acceptance by the DEN Project Manager does not relieve the Contractor of its responsibility to comply with the Contract Requirements. The Contractor Quality Control Plan shall address the following as a minimum:

1. A general description of Quality Control monitoring to be performed until final acceptance by DEN. Include monitoring activities of Work and the work site during times that no construction activity is scheduled to take place.
  - a. No work requiring QC inspection and testing shall take place without QC inspection and testing staff on site.
2. An individual designated by the Contractor and approved in writing by the DEN Project Manager whose [sole] responsibility is Quality Control Management. This individual shall be highly qualified in all phases of construction as it relates to this Project and shall have the authority to direct work changes required to bring the Work into conformance with Contract requirements, including stopping non-conforming work in progress. A detailed resume of the proposed Quality Control Manager including applicable education, experience, and certifications shall be included in the Quality Control Plan.
  - a. At the discretion of the DEN Project Manager, for Small Projects, Early Work Packages and Task Orders all of value less than \$1,000,000 or a duration which is less than three (3) months, the Contractor may assign one of the Contractor's staff, i.e. Contractor's Superintendent, Office Engineer, Field Engineer, or Contractor's Project Manager as Quality Control Manager. The assigned person must be on site while work requiring QC inspection and testing is being completed and available to discuss quality issues, manage all aspects of the Project Quality Control Plan, coordinate all required Special Inspection and Quality Assurance testing, and provide proposed solutions on all quality issues at any time as to not cause any delay to the project. Any delays caused in part or in all due to defective or no conforming work shall be borne by the Contractor.
3. Quality Control inspection staff as needed to assist the Quality Control Manager with implementation of the Quality Control Program. Duties of the Quality Control Inspectors shall be limited strictly to inspection of the ongoing work. Sampling and testing of materials shall be performed by Quality Control personnel other than Quality Control Inspectors. Quality Control Inspectors shall inspect only those work elements for which they are qualified. Resumes of the proposed Quality Control Inspectors including applicable education, experience and certifications shall be included in the Quality Control Plan.
4. An Organization Chart identifying all Quality Control staff by name and function. The chart shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of work including tests performed by the CTA or DTA. If necessary, different Quality Control staff can be utilized for specific inspection and testing functions for different items of work. The chart shall show that the Quality Control Manager, Quality Control Inspectors, and Quality Control testing personnel are outside of

- the production staff with clear lines of authority for Quality Control.
5. The City and/or the City Program Management Team acting as the City agent will employ a DTA. The Contractor's testing and inspection shall be performed for the processing, preparation and to request City's inspection and as necessary to produce the required product as specified in the Contract Documents. The Contractor shall meet the minimum inspection and testing frequencies specified in the contract documents. When the contract documents do not specify minimum inspection and testing frequencies the Contractor shall propose in writing to the DEN Project Manager a QC inspection and testing frequencies that meet or exceed industry standards for the material and work being placed or conducted.
  6. Any test performed by any agency on the Project shall be recorded and show a passing re-test of all failing tests.
    - a. All test results shall be made available for inspection by the DEN Project Manager. This includes tests that are above the QC testing frequency required.
  7. Any tests submitted by the Contractor for basis of acceptance, or payment reduction when performed by the Contractor's agency, must meet all standards and must be certified to have followed approved procedure, processed in a certified lab by properly certified or licensed personnel by properly certified testers and on calibrated and certified equipment. Authentications of tests must be preapproved and cannot be selectively submitted. All tests shall be recorded in the field witnessed by DEN inspector to be accepted as a record test of the material in question. Any failing tests could be the sole basis for rejecting the material.
  8. Each technical specification division's requirements for quality control identifying each item requiring submittal and approval/acceptance prior to installation of work, all inspections to be performed during work and prior to acceptance of work, each item of work requiring testing by the independent testing agency or the City provided testing agency, and the testing frequency.
  9. The plan shall address all elements of special inspection required by the statement of special inspection as approved by the Building Official. All special inspections and tests will be performed by agencies employed by the City.
  10. The Contractor is responsible for the complete record of inspection file including but not limited to all manufacturer certificates, certificates of material compliance, Certificates of Material Testing Record, successful re-inspection of all deficiency items, proper deposition of design related Non-Conformance reports (NCR), Structural Engineers' observation reports, certification letters from the DTA, Building Inspectors' records of approvals, permit cards, fire suppression and fire-alarm tests records as witnessed by the authorities of jurisdiction and any record necessary to achieve a certificate of occupancy.
  11. The Contractor must keep track of all logs of discrepancies and submit periodic updates, as required by the DEN Project Manager, of all open issues and track the closure of open items in a timely manner.
  12. Establish controls and documentation format to ensure that items or materials that have been accepted through receiving inspection are used or installed. Identification and traceability shall be provided throughout all inspections, test activities, and records. For stored items, provisions shall be made for the control

- of item/material identification, consistent with the expected duration and type of storage.
13. A methodology of monitoring, testing, and exercising of all equipment, valves, and/or assemblies to ensure the Work installed is in proper working order.
  14. A list of suppliers and subcontractors. This list shall include items to be supplied by each supplier and/or subcontractor and shall identify work to be performed by each subcontractor. The list shall be updated and resubmitted as required.
  15. All approvals related to Special Inspection are subject to the acceptance or approval of the Building Official.
  16. Emergency contact information including name, company, title, work phone number, home phone number, and other means of contact. The Emergency Contact list shall include at least four individuals. The Emergency Contact list shall be maintained on a daily basis. In the event there is any change in any of the information, the Contractor shall forward the updated list to the DEN Project Manager and to DEN Maintenance Control (303-342-2800). The Emergency Contact list shall include the project number, project title, and date of issue.
- C. The Contractor shall transmit the following daily reports to the DEN Project Manager electronically PRIOR TO THE CLOSE OF BUSINESS ON the following work day:
1. CM-13 Contractors Daily Construction Report. The Foreman may add sheets of information to this form as needed.
  2. CM-07 Daily Quality Control Inspection Report and all CTA test results performed that day.
  3. CM-08 Daily DEN Time and Materials Report
- D. Deficiency List: The Quality Control Manager shall establish a deficiency list including the minimum information for each deficiency item; description, date, location, drawings reference, detail reference, specification reference, and superseding document NCR, date of expected solution date repaired date inspected by City representative and accepted.
- 1.4 DOCUMENTATION
- A. The Contractor shall not change or alter approved submittals, procedures, specifications, drawings/MODELS, or other pertinent documentation without the DEN Project Manager's written authorization.
  - B. All records and documents that are quality related shall be prepared, identified and maintained by the Contractor and shall be made available to DEN upon request. Records shall be protected from damage, deterioration, or loss. A copy of the records and documents shall be maintained at the Work site at all times unless the DEN Project Manager has approved other locations in writing. Retention time for all quality records shall be not less than three (3) years from date of Final Acceptance of the Contract.
  - C. The Contractor is responsible for the complete record of inspection file including but not limited to all manufacturer certificates, certificates of material compliance, Certificates of Material Testing Record, successful re-inspection of all deficiency items,

proper deposition of design related NCRs, Structural Engineers' observation reports, certification letters from the DTAs, Building Inspectors' records of approvals, permit cards, fire suppression and fire-alarm tests records as witnessed by the authorities of jurisdiction and any record necessary to achieve a Certificate of Occupancy.

- D. The Contractor shall maintain records at the actual worksite and at Contractor's office to show the inspection status of materials and items installed in order to ensure that the required inspections and tests have been performed in a timely and correct manner.
- E. The Contractor must keep a record of all deficiency issues and show positive evidence of closure (passing re-inspection or re-test) to every issue.

## 1.5 INSPECTIONS AND TESTS

- A. Inspections, tests and system shut down requests, conducted by persons or agencies other than the Contractor, shall not in any way relieve the Contractor of the responsibility and obligation to meet all specifications and the referenced standards. The Contractor's designated Quality Control Representative shall inspect the work and shall ensure the Work complies with the Contract requirements prior to any requests for inspection or testing.
- B. When the specifications, laws, ordinances, rules, regulations or orders of any public agency having jurisdiction require the DEN Project Manager's surveillance of inspections or tests, the Contractor shall notify the DEN Project Manager, in writing, of the place, date and time 48 hours prior to the inspection and/or test. The Contractor shall be responsible for notifying and requesting inspection by other agencies including but not limited to the Denver Building Inspection Division, Denver Fire Department, and Denver Water Department. Prior to request for other agency inspections, the Contractor shall meet and plan inspection times with the DEN Project Manager.
- C. Special inspections or tests may be required by the technical specifications, City, State and/or Federal Agencies in addition to those tests already performed. The Contractor shall notify the DEN Project Manager, in writing, at least 48 hours in advance of the additional inspections or tests.
- D. Quantities will be verified as defined in the Pre-Work Meetings.

## 1.6 INSPECTION PLAN

- A. The Contractor shall utilize the following six-point inspection plan to ensure the conformance of the Work performed by the Contractor meets the requirements of the Contract Drawings and specifications, the referenced codes and standards and the approved submittals:
  - 1. Pework Coordination: Prior to the start of construction work on the Contract and prior to the start of Work under each separate specification section and prior to the start of Work where a change in a construction operation is contemplated by

the Contractor, and prior to a new subcontractor starting work, a coordination meeting to ensure that the Contractor's personnel have no misunderstandings regarding their safety and quality procedures as well as the technical requirements of the Contract will be held with the Contractor's superintendent, Quality Control and Safety representatives, and DEN Project Manager. Supervisory, Safety and Quality Control, representatives of all applicable subcontractors will also attend. Prior to the meeting, the Contractor's Quality Control Manager shall provide the DEN Project Manager with a meeting agenda for review. The Contractor's Quality Control Manager shall conduct the meeting and distribute the approved agenda. The Quality Control Manager shall develop and electronically distribute finalized meeting minutes within one business day upon completion of the meeting. The following items shall be presented and reviewed by the Contractor:

- a. Contract requirements and specifications.
  - b. Shop drawings, certifications, submittals, models, and as-built drawings.
  - c. Testing and inspection program and procedures.
  - d. Contractor's Quality Control program.
  - e. Familiarity and proficiency of the Contractor's and subcontractor's workforce to perform the operation to required workmanship standards including certifications of installers.
  - f. Safety, security, and environmental precautions to be observed.
  - g. Any other preparatory steps dependent upon the particular operation.
  - h. The Contractor's means and methods for performing the Work.
2. Initial Inspection: Upon completion of a representative sample of a given feature of the Work and no later than two weeks after the start of a new or changed operation, the DEN Project Manager and/or the DEN Project Manager's designated representatives will meet with the Contractor's Quality Control representative and applicable subcontractor's supervisor and their Quality Control representatives to check the following items, as a minimum:
- a. Workmanship to established quality standards.
  - b. Conformance to Contract Drawings, specifications and the accepted shop drawings.
  - c. Adequacy of materials and articles utilized.
  - d. Results of inspection and testing methods.
  - e. Adequacy of as-built drawings/MODELS maintained daily.
  - f. Once accepted, the representative sample will become the physical baseline by which ongoing work is compared for quality and acceptability. To the maximum practical extent, approved representative samples of work elements shall remain visible until all work in the appropriate category is complete. Acceptance of a sample does not waive or alter any Contract requirements or show acceptance of any deviation from the Contract not approved in writing by the DEN Project Manager.
3. Follow-up Inspection: The Contractor's Quality Control representative will monitor the Work to review the continuing conformance of the Work to the workmanship standards established during the preparatory and initial inspections.
4. Completion Inspection: Forty-eight (48) hours prior to the completion of an item

or segment of work and prior to covering up any work, the Contractor shall notify the DEN Project Manager, in writing, who will verify that the segment of work is substantially complete, all inspections and tests have been completed and the results are acceptable. The purpose of this inspection is to allow further corrective work upon, or integral to, the completed segment of work. THIS IS NOT AN ACCEPTANCE INSPECTION. If any items are determined to be deficient, need correction or are non-conforming, a Deficiency List will be prepared and issued to the respective Contractor for correction, repair, or replacement of any deficient or non-conforming items. The DEN Project Manager and Contractor's Quality Control representative will verify the correction of the deficient and/or non-conforming items prior to the start of the next operation.

5. Pre-Final Acceptance Inspection: Prior to requesting a Pre-Final Acceptance Inspection by DEN, all work and operational systems to be inspected shall be satisfactorily completed and tested by the Contractor. The Contractor's written request for this inspection shall be made seventy-two (72) hours in advance. With the request shall come a list of any known deficiencies and when they will be corrected. If the list is too large or contains too many significant items, in the opinion of the DEN Project Manager, no inspection will be held because of the incompleteness of the Work.
6. The DEN Project Manager will schedule the Pre-Final Acceptance Inspection and will prepare a list of deficient items (punch list) discovered during the inspection. If during the inspection, the list becomes too large or too many significant items are on the list, the inspection will be canceled by the DEN Project Manager. After the inspection is completed, the Deficiency List will be transmitted to the Contractor for correction of the deficient items.
7. Final Acceptance Inspection: After the Contractor has completed all items on the Deficiency List (generated from the Pre-Final Acceptance Inspection), he shall request a Final Acceptance Inspection. The request shall be made in writing at least seventy-two (72) hours in advance of the inspection. All areas must be cleaned and ready for turnover prior to this inspection. The DEN Project Manager, the design consultant, a representative of the funding agency (if applicable) and other interested parties will inspect the subject Work to ensure that all deficiencies have been satisfactorily attended to and that no new deficiencies have appeared and that all systems are completely functional. Any outstanding or additional deficient items will be noted and handled per the requirements of the Pre-Final Acceptance Inspection noted above until the Work is acceptable to the DEN Project Manager.

## 1.7 CONTRACTOR SUBMITTAL OF PROPOSED CONTRACTOR'S TESTING AGENCIES

- A. Refer to Section 014525 - Material Testing Agency



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## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 REQUIREMENTS**

- A. All materials required for the Contract shall be new except where specified otherwise. The DEN Project Manager may elect to perform additional inspections and/or tests at the place of the manufacture, the shipping point or at the destination to verify conformance to applicable specifications. Inspections and tests performed by DEN shall not relieve the Contractor from the responsibility to meet the specifications, nor shall such inspections/tests be considered a guarantee for acceptance of materials that will be delivered at a later time.
- B. Materials accepted based on a Certificate of Compliance may be sampled and inspected/tested by DEN or its designer at any time. The fact that the materials were accepted based on such certification shall not relieve the Contractor of the responsibility to use materials that conform to the specifications.
- C. The Contractor shall impose upon suppliers the same quality control requirements, including inspection and test procedures, as imposed upon him by the specifications and referenced standards. The Contractor shall apply appropriate controls, designed to ensure that all materials supplied meet the requirements and specifications.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

- A. No separate payment will be made for work under this Section.
- B. Refer to Article 1706 - Removal of Defective Materials and Work in the General Contract Conditions, 2011 Edition.

**END OF SECTION 014510**

## **SECTION 014520 - CONTRACTOR QUALITY CONTROL PROGRAM - FAA**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. The Contractor shall establish, provide and maintain an effective Quality Control Program that details the methods and procedures that will be taken to ensure that all materials and completed construction required by this Contract conform to Contract Documents and any other requirements, whether manufactured by the Contractor or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the Contract Documents, the Contractor shall assume full responsibility for accomplishing the stated purpose.

#### **1.3 LEVEL OF CONTROL**

- A. The intent of this Section is to explain the Contractor's need to establish a necessary level of control that will:
  - 1. Adequately provide for the production of acceptable quality materials.
  - 2. Provide sufficient information to ensure both the Contractor and the DIA Project Manager that the Contract requirements are being met.
  - 3. Allow the Contractor as much latitude as possible to develop the Contractor's own standards of control.

#### **1.4 REQUIREMENTS**

- A. The Contractor shall be prepared to discuss at the Preconstruction Conference, the Contractor's understanding of the quality control requirements. A written Quality Control Plan shall be submitted to the DIA Project Manager no later than ten (10) days after the Notice to Proceed. The Contractor shall not begin any construction, production or off-site fabrication of materials to be incorporated into the completed work until the Quality Control Plan has been reviewed and approved by the DIA Project Manager. No partial payment will be made for work or materials subject to specific quality control requirements until the Quality Control Plan has been reviewed and approved by the DIA Project Manager.
- B. The quality control requirements contained in this Section and elsewhere in the

Contract Documents are in addition to and separate from the acceptance testing requirements. Certain acceptance testing requirements as noted in the specifications are also the responsibility of the Contractor.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 QUALITY CONTROL PROGRAM**

- A. General Description: The Contractor shall establish a Quality Control Program to perform inspection and testing of all items of Work required by the Contract Documents, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable specifications and plans with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the Contract Documents in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.
- B. Quality Control Plan: The following Quality Control Plan shall be submitted within ten (10) days of receiving the Administrative Notice to Proceed (NTP) in a MS Word or MS Excel format that can easily be incorporated into the FAA Construction Management Plan. The Contractor shall describe the Quality Control Program in a written plan. The Quality Control Plan shall provide a general description of minimum quality control monitoring required to be performed for each specification division until Final Acceptance by DIA.
1. The Quality Control Plan shall address and establish controls and documentation to ensure that only items or materials that have been accepted through successful inspection are used or installed. Identification and traceability of construction materials shall be provided throughout all inspections, test activities and records. For stored items, provisions shall be made for the control of the item/material identification, consistent with the expected duration and type of storage.
  2. The Quality Control Plan shall describe the methodology of monitoring, testing and exercising of all equipment, valves and/or assemblies to ensure the Work installed is in proper working order.
  3. In addition, the Quality Control Plan shall be organized to address, as a minimum, the following items:
    - a. Quality control organization and personnel.
    - b. Inspection requirements.
    - c. Quality control testing plan.
    - d. Documentation of quality control activities.
    - e. Requirements for corrective action when quality control and/or acceptance

- criteria are not met.
- f. Testing Agencies Certifications, personnel certifications, equipment lists, test forms, report samples and forms, frequency of tests, specification references, and specification standards.
  - g. Acceptance tests required and methods of quality control for each activity included in the Contract Documents.
4. The Contractor is encouraged to add any additional elements to the Quality Control Plan that he/she deems necessary to adequately control all production and/or construction processes required by this Contract.

### 3.2 QUALITY CONTROL ORGANIZATION

- A. The Contractor's Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.
1. The organizational chart shall identify all quality control staff by name and function and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item or work. If necessary, different technicians can be utilized for specific inspection and testing functions for different items of work. All personnel used for implementation of all or part of the Quality Control Program shall be subject to the qualification requirements of this Section. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.
- B. The quality control organization shall consist of the following minimum personnel:
1. Quality Control Manager:
    - a. The Quality Control Program shall be administrated by a Quality Control Manager. The Quality Control Manager shall be a full-time employee of the Contractor or a consultant engaged by the Contractor. The Quality Control Manager shall have a minimum of five (5) years of experience in airport and/or highway construction and shall have had prior quality control experience on a project of comparable size and scope as this Contract.
    - b. Additional qualifications for the Quality Control Manager shall include the following requirements:
      - 1) A licensed professional engineer with a minimum of five (5) years of airport or highway grading and drainage paving, field and laboratory testing, and quality control experience acceptable to the DIA Project Manager, or,
      - 2) A technician certified at Level III or IV by the National Institute for Certification in Engineering Technologies (NICET) for Construction Materials, Highway Materials, Highway Construction or five (5) years of highway and/or airport paving experience in all fields of work

- included in the scope of work and acceptable to the DIA Project Manager.
- 3) Submit the following documentation to the DIA Project Manager for review:
    - a) A current resume including the individual's experience and qualifications.
    - b) Copy of current PE registration and/or all applicable certifications.
    - c) Four (4) references for work on projects completed within past five (5) years, including names, current organization, and telephone numbers.
  - c. The Quality Control Manager shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the Contract Documents. The Quality Control Manager shall report directly to a responsible officer of the construction firm. The Quality Control Manager shall be on-site for a minimum of forty (40) hours per week during all production and shall be released from full-time duties only after written permission from the DIA Project Manager.
2. Electrical Quality Control Manager: Depending on the project's scope of work, the Contractor shall provide a dedicated, full-time Electrical Quality Control Manager. The Electrical Quality Control Manager shall have no other responsibilities other than overall electrical quality control. The Electrical Quality Control Manager shall be a master electrician with a minimum of five (5) years electrical airfield construction experience at a commercial carrier airport. The Electrical Quality Control Manager shall be a Certified Senior Technician.
    - a. The Quality Control personnel:
      - 1) Shall be familiar with and prove proficiency in all aspects of inspections and testing he/she is supervising.
      - 2) Shall not perform any testing or inspection he/she is not certified to perform.
      - 3) Shall be subject to the approval of DIA Project Manager.
      - 4) Shall not report or be part of the production team on the Project.
  3. Quality Control Inspection Technicians: A sufficient number of Quality Control Inspection Technicians necessary to adequately implement the Quality Control Program shall be provided by the Contractor. The Quality Control Inspection Technicians shall have the authority to bring the Work into conformance with Contract requirements including stopping non-conforming work in progress. A document signed by an officer of the Contractor shall convey and acknowledge the Inspector's authority. Inspection personnel shall be engineers, engineering technicians, or experienced craftsman with the following qualifications:
    - a. Engineer-in-training with minimum two (2) years of airport/highway grading experience acceptable to the DIA Project Manager.

- b. An individual with 3 years of highway and/or airport grading experience acceptable to the DIA Project Manager, with a Bachelor of Science degree in Civil Engineering, Civil Engineering. Technology or Construction.
  - c. The Quality Control personnel:
    - 1) Shall be familiar and prove proficiency in all aspects of inspections and testing he or she is supervising.
    - 2) Shall not perform any inspection he/she is not certified to perform.
    - 3) Shall be subject to the approval of DIA Project Manager.
    - 4) Shall not report or be part of the production team on the Project.
  - d. The Quality Control Inspection Technicians shall report directly to the Quality Control Manager and shall perform the following functions:
    - 1) Inspection of all materials, construction, plant and equipment for conformance to the Technical Specifications, and as required by Article 3.3 below
    - 2) Performance of all quality control tests as required by the Technical Specifications and Article 3.4 of this Section.
- C. If the DIA Project Manager determines that the Quality Control Manager or any of the Quality Control Manager's authorized support personnel are not effectively enforcing or performing the Quality Control requirements specified in the Contract, the DIA Project Manager will, in writing, require the Contractor to remove and replace such personnel from the Project at no cost to the City. No further work will be performed by the Contractor until an acceptable replacement for the replaced personnel is approved by the DIA Project Manager.
- D. Staffing Levels: The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the Work, separate plant and field testing technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Plan shall state where different technicians will be required for different work elements. Should the DIA Project Manager determine that staffing levels are not sufficient to ensure compliance with the Quality Control Plan and Contract Documents, the Quality Control Manager shall take steps to bring staffing levels to an acceptable level.
- E. Suppliers and Subcontractors: The Quality Control Plan shall include a list of suppliers and subcontractors. The list shall include items to be supplied by each supplier and/or subcontractor and shall identify work to be performed by each subcontractor. The list shall be updated and submitted as required.
- F. Emergency Contact Information: Provide the name, company, title, work phone number, home phone number, and other means of contact for at least four (4) individuals. The individuals can be associated with production and/or quality control. The Emergency Contact list shall be revised in the event there is any change in any of the information and forwarded to the DIA Project Manager and DIA Maintenance Control (303-342-2800). The Emergency Contact list shall also include the project

number, title and date of issue.

### 3.3 INSPECTION REQUIREMENTS.

- A. The Contractor shall utilize the following six-point inspection plan to ensure the conformance of the Work performed by the Contractor meets the requirements of the Contract Documents, the referenced codes and standards and the approved submittals:
1. **Prework coordination:** Prior to the start of construction work on the Contract and prior to the start of work under each separate specification section and prior to the start of work where a change in a construction operation is contemplated by the Contractor and prior to a new subcontractor starting work, a coordination meeting will be held with the Contractor's Quality Control Manager, Project Manager, Superintendent, Foreman, Safety representative, Quality Control Inspector(s), MTA representative, and the DIA Project Manager, DIA Inspector(s), and DIA Quality Assurance Laboratory representative. Supervisory, Safety, and Quality Control representatives of all applicable subcontractors will also attend. The Contractor's Quality Control Manager will chair the meeting and shall distribute the proposed meeting agenda 48 hours prior to the meeting. Upon completion of the meeting, minutes including any revisions to the agenda shall be distributed within twenty-four (24) hours.
  2. The purpose of the coordination meeting is to ensure that the Contractor's personnel have no misunderstandings regarding their safety and quality procedures as well as the technical requirements of the Contract. The following items shall be submitted to the DIA Project Manager no less than seventy-two (72) hours prior to the meeting and shall be presented and reviewed by the Contractor at the meeting held no less than forty-eight (48) hours prior to start of work:
    - a. Contract requirements and specifications.
    - b. Shop drawings, certifications, submittals and as-built drawings that apply.
    - c. Testing and inspection program and procedures.
    - d. Contractor's Quality Control Program.
    - e. Familiarity and proficiency of the Contractor's and subcontractor's workforce to perform the operation to required workmanship standards including certifications of installers.
    - f. Safety and environmental precautions to be observed.
    - g. Any other preparatory steps dependent upon the particular operation.
    - h. The Contractor's means and methods for performing the Work.
  3. **Initial Inspection:** Upon completion of a representative sample of a given feature of the Work and no later than two (2) weeks after the start of a new or changed operation, the DIA Project Manager or the DIA Project Manager's designated representative will meet with the Contractor's Quality Control representative and applicable subcontractor's supervisor and their Quality Control representatives to check the following items, as a minimum:
    - a. Workmanship to established quality standards.

- b. Conformance to Contract Documents and the accepted shop drawings.
  - c. Adequacy of materials and articles utilized.
  - d. Results of inspection and testing methods.
  - e. Adequacy of as-built drawings maintained daily.
  - f. Once accepted, the representative sample will become the physical baseline by which ongoing work is compared for quality and acceptability. To the maximum practical extent, approved representative samples of work elements shall remain visible until all work in the appropriate category is complete. Acceptance of a sample does not waive or alter any Contract requirements or show acceptance of any deviation from the Contract not approved in writing by the DIA Project Manager. The Contractor's Quality Control representative shall chair, prepare and distribute minutes of Quality Control meetings. Meeting minutes shall be distributed within twenty-four (24) hours of the meeting.
4. Follow-up Inspection: The Contractor's Quality Control representative will monitor the Work to review the continuing conformance of the Work to the workmanship standards established during the preparatory and initial inspections.
  5. Completion Inspection: Forty-eight (48) hours prior to the completion of an item or segment of work and prior to covering up any work, the Contractor will notify the DIA Project Manager who will verify that the segment of work is substantially complete, all inspections and tests have been completed and the results are acceptable. The purpose of this inspection is to allow further corrective work upon, or integral to, the completed segment of work. THIS IS NOT AN ACCEPTANCE INSPECTION. If any items are determined to be deficient, need correction or are non-conforming, a deficiency list will be prepared and issued to the respective Contractor for correction, repair or replacement of any deficient or non-conforming items. The DIA Project Manager and Contractor's Quality Control representative will verify the correction of the deficient and/or non-conforming items prior to the start of the next operation.
  6. Pre-Final Acceptance Inspection: Prior to requesting a Pre-final Acceptance Inspection by DIA, all work and operational systems to be inspected shall be satisfactorily completed and tested by the Contractor. The Contractor's written request for this inspection shall be made seventy-two (72) hours in advance. With the request shall come a list of any known deficiencies (punch list) and the time frame in which they will be corrected. If the list is too large or contains too many significant items, in the opinion of the DIA Project Manager, no inspection will be held due to the incompleteness of the Work.
    - a. The DIA Project Manager will schedule the Pre-final Acceptance Inspection and will add to the punch list deficient items discovered during the inspection. If during the inspection the list becomes too large or too many significant items are on the list, the inspection will be canceled. After the inspection is completed, the deficiency list will be transmitted to the Contractor for correction of the deficient items.
  7. Final Acceptance Inspection: After the Contractor has completed all items on the deficiency list (generated from the Pre-final Acceptance Inspection) he/she shall request a Final Acceptance Inspection. The request shall be made in



writing at least seventy-two (72) hours in advance of the inspection. All areas must be cleaned and ready for turnover prior to this inspection. The DIA Project Manager, the design consultant, a representative of the funding agency, if applicable, and other interested parties will inspect the subject Work to ensure that all deficiencies have been satisfactorily attended to and that no new deficiencies have appeared and that all systems are completely functional. Any outstanding or additional deficient items will be noted and handled per the requirements of the Pre-final Acceptance Inspection noted above until the Work is acceptable to the DIA Project Manager.

### 3.4 QUALITY CONTROL TESTING PLAN.

- A. As a part of the overall Quality Control Program, the Contractor shall implement a Quality Control Testing Plan as required by the specifications. The testing plan shall include the minimum tests and test frequencies required by each item in the Contract Documents as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.
- B. The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:
  - 1. Specification item number (e.g., P-401).
  - 2. Item description (e.g., Plan Mix Bituminous Pavements).
  - 3. Test type (e.g., gradation, grade, asphalt content).
  - 4. Test standard (e.g., ASTM or AASHTO test number, as applicable).
  - 5. Test frequency (e.g., as required by specifications or minimum frequency when requirements are not stated).
  - 6. Responsibility (e.g., plant technician).
  - 7. Control requirements (e.g., target, permissible deviations).
- C. The testing plan shall contain a statistically based procedure of random sampling for acquiring test samples in accordance with ASTM D 3665. The DIA Project Manager shall be provided the opportunity to witness quality control sampling and testing.
- D. All quality control test results shall be documented by the Contractor as required by this Section.

### 3.5 DOCUMENTATION.

- A. The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, results of inspections or tests, nature of defects, deviations, causes for rejection, etc., proposed remedial action, and corrective actions taken.
- B. These records must cover both conforming and defective or deficient features and must include a statement that all supplies and materials incorporated in the Work are in full compliance with the terms of the Contract. Legible copies of these records shall

be furnished to the DIA Project Manager daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Manager.

- C. Specific Contractor quality control records required for the Contract shall include, but are not necessarily limited to, the following records:
1. Certificates of compliance shall be submitted minimum thirty (30) days prior to the product's incorporation into the Work.
  2. Quality Control Charts for materials shall be established as required by the individual specification sections.
  3. Daily Foreman Report: The Foreman shall report daily construction activities using the Daily Foreman Report form QCP-1 as included in Specification Section 019990 "Standard Forms". The reports shall be completed in their entirety and shall as a minimum include the following:
    - a. Daily activities.
    - b. Quantities of material placed and completed.
    - c. Weather.
    - d. Safety issues.
    - e. Personnel.
    - f. Equipment on site with time used.
    - g. Equipment under repair.
    - h. Work delays.
    - i. Possible delays.
    - j. Materials delivered.
    - k. The reports shall be signed by the responsible foreman and Contractor Superintendent. The DIA Project Manager shall be provided a copy of each daily construction report on the work day following the day of record.
  4. Daily Quality Control Inspection Reports: Each Contractor Quality Control Inspection Technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on forms QCP-2 and QCP-2-2 included in Section 019990 "Standard Forms". The reports shall be completed in their entirety, shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:
    - a. Technical Specification item number and description.
    - b. Compliance with approved submittals.
    - c. Proper storage of materials and equipment.
    - d. Adherence to plans and specifications.
    - e. Review of quality control tests.
    - f. Compliance of quality control testing frequencies.
    - g. Identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, remedial or corrective actions taken or proposed.
    - h. The reports shall be signed by the responsible Quality Control Inspection Technician and the Program Manager. The DIA Project Manager shall be provided a copy of each report on the workday following the day of record.

5. Test Reports: The Contractor shall be responsible for establishing a system which will record all quality control test results. Daily test reports shall document the following information:
  - a. Technical Specification item number and description.
  - b. Test designation.
  - c. Location.
  - d. Date of test.
  - e. Control requirements.
  - f. Test results.
  - g. Causes for rejection.
  - h. Recommended remedial actions.
  - i. Retests.
  - j. Fresh concrete properties tests and in-place moisture-density tests shall be reported in legible draft form to the DIA Inspector immediately at the test site. Any failing test shall be reported separately to a DIA Inspector or the DIA Project Manager within two (2) hours after the discovery.
  - k. Test results from each day's work period shall be transmitted to the DIA Project Manager on the next work day. These initial daily test reports shall be signed by the responsible Quality Control Technician and the Program Manager.
  - l. Typed final laboratory and field tests shall be provided to the DIA Project Manager as specified in paragraph 3.5.D "Weekly Summary Reports" below.

D. Weekly Summary Reports:

1. Typed final laboratory and field test reports summarizing the activities and results for the quality control tests and inspections for each week shall be prepared by the ITA and submitted to the DIA Project Manager. The weekly summary report shall meet the requirements of Section 014525 "Material Testing Agency" and be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all test types, test locations, testers, test results, worksheets showing all calculations used, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, the material supplier, installer, and Contractor. Retests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report. A current Correction Action Report (CAR) log shall also be included in the weekly summary report.

### 3.6 CORRECTIVE ACTION REQUIREMENTS

- A. The Quality Control Plan shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process under control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the specifications.

- B. The Quality Control Plan shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.
- C. When applicable or required by the specifications, the Contractor shall establish and utilize statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

### 3.7 SURVEILLANCE BY THE DIA PROJECT MANAGER

- A. All items of material and equipment shall be subject to surveillance by the DIA Project Manager at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed herein and the applicable Contract Documents. In addition, all items of materials, equipment and work in place shall be subject to surveillance by the DIA Project Manager at the site for the same purpose.
- B. Surveillance by the DIA Project Manager does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

### 3.8 NONCOMPLIANCE

- A. The DIA Project Manager will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the DIA Project Manager or the DIA Project Manager's authorized representative to the Contractor or the Contractor's authorized representative at the site of the work, shall be considered sufficient notice.
- B. In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the Contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the DIA Project Manager, the DIA Project Manager may:
  - 1. Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors
  - 2. Order the Contractor to stop operations until appropriate corrective actions are taken.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

**END OF SECTION 014520**

## SECTION 014525 - MATERIAL TESTING AGENCY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Contractor shall employ the services of a Material Testing Agency; hereafter referred to as the Contractor Testing Agency (CTA). This Section identifies the requirements for the Contractor to employ a Material Testing Agency and identifies the required activities of the Material Testing Agency.
- B. Laboratory and field-testing requirements to be conducted by the CTA for materials and construction methods used on this project are included in the appropriate technical specifications. Where the Specifications reference the CDOT Standard Specifications for Road and Bridge Construction, the references shall also mean CDOT Field Materials Manual for schedule of tests unless otherwise stated. As a minimum, the CTA described in this Section shall perform all applicable tests listed in the manual including the independent assurance sampling and testing. In the event of such a conflict between the schedule and a specification in these technical provisions, the more comprehensive testing shall govern unless otherwise noted.
- C. Inspections and tests conducted by the CTA shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet all specifications and referenced standards. Employment of the CTA does not relieve the Contractor of providing the required Quality Control program.
- D. When inspections or tests by the CTA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor as per this Section.
- E. Samples will only be considered if taken at random. The Contractor shall permit representatives of the City to witness the selection of samples. Inspection or tests of items or materials that fail shall be sufficient cause to terminate further inspections/tests of the same brand, make or source of that product.
- F. The Contractor is obligated to correct any item deemed deficient at no additional cost to DEN.

#### 1.3 SUBMITTALS

- A. All submittals shall comply with requirements of Sections 013300 "Submittal

Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal requirements.

#### 1.4 CONTRACTOR SUBMITTAL OF PROPOSED TESTING AGENCIES

- A. The Contractor shall employ the services of a CTA that has been accredited by AASHTO or CCRL or an approved equal to perform the tests required in the Contract. The CTA may also provide technicians to perform the required inspections. However, inspection and testing cannot be performed simultaneously by the same technician. The Contractor shall receive written acceptance from the DEN Project Manager of the CTA prior to any permanent work being installed or tested.
- B. The Contractor shall not submit for acceptance to the DEN Project Manager any testing agency or laboratory utilized in the design or construction document preparation or presently employed by DEN as part of DEN Quality Assurance, Material Testing, or special inspection agencies.
- C. For consideration of acceptance, the Contractor shall submit to the DEN Project Manager the following items received from the CTA:
  - 1. Affidavit of current accreditation from a national certification and/or accreditation programs.
  - 2. Evidence that the CTA Laboratory is accredited to perform the testing required in the Contract Documents.
  - 3. Resumes and evidence of professional engineer registration and licensing in the State of Colorado for the personnel reviewing and signing test reports.
  - 4. Resumes and current certifications verifying that CTA management and supervisory personnel, laboratory staff, field testing technicians, and inspecting technicians are qualified in accordance with ASTM C 1077, D 3666, D 3740, and E 329 requirements to perform the Work. NICET, ACI, WAQTC, LabCAT, CDOT, NRMCA, PCA, AWS, ASNT certifications or a degree in a related engineering field with construction field experience that can demonstrate qualifications. A list summarizing all management, supervisory, laboratory, field testing, and inspection personnel assigned to the Project including the testing and/or inspection each individual will be performing, certifications held by each individual, and the expiration date of each certification.
  - 5. A matrix indicating each technical specification section, paragraph, quantity and type of sampling and/or testing required.
  - 6. Copies of all laboratory, field testing, and inspection report forms.

#### 1.5 SUBMITTAL OF REPORTS

- A. Test results shall be submitted by the Contractor to the DEN Project Manager after completion of inspections/tests by the CTA and prior to incorporation of the items into the Work unless the test or inspection must be done during or after installation.
- B. All field test results including but not limited to fresh concrete properties and in-place moisture-density shall be reported in legible draft form to the DEN Inspector

immediately at the test site. Any failing test shall be reported separately to the DEN Inspector or DEN Project Manager. The draft test results shall also be attached to the Daily Quality Control Inspection Report (reference Section 014510 "Contractor Quality Control") and transmitted to the DEN Project Manager the next workday.

- C. Typed test reports shall be provided to the DEN Project Manager as specified in the "Weekly Reports" Article in this Section. The test reports shall be numbered sequentially in chronological order. Individual tests shall be numbered sequentially. The reports and tests shall also be organized per specification section. All test results must be reviewed and signed by a registered licensed engineer in the State of Colorado. The signature represents that the test procedures used are in strict conformance with the applicable testing standard, the calculated data are true and accurate, the tools and equipment used were in calibration, the sample was not contaminated and the persons running the test were qualified.
- D. Reports of inspections and test activities are record documents and shall be maintained in a manner that provides integrity of item identification, acceptability, and traceability. Reports shall identify the following:
1. Contractor's name.
  2. DEN Contract number and title.
  3. Material Testing Agency name.
  4. Name of items inspected/tested including a physical description and, as applicable, model and make.
  5. Quantity of items.
  6. Inspection/test procedure used. If national standards are used, any deviation from these standards.
  7. Date the sample was taken and the date the test was made.
- E. Location (by coordinates, building grid or station number and elevation) of where tests and/or samplings were performed including environmental condition where applicable. Include plan drawing indicating location of test, lot size and location and work item sampled or tested.
1. Name of inspector/tester.
  2. In the event the testing or sampling is a re-test or re-sampling, reference the previous respective testing or sampling report.
  3. Specified requirements in the Contract that the item must meet. Include reference to technical specification section and paragraphs.
  4. Acceptability.
  5. Deviations/nonconformance.
  6. Evaluation of results.
  7. All information required for the specific test as specified in the applicable ASTM standard.
  8. Signature of authorized evaluator.

## 1.6 WEEKLY SUMMARY REPORTS

- A. The CTA and Quality Control Manager shall prepare and submit to the DEN Project



Manager a weekly summary report each week, which summarizes by specification section all work activities and results for the quality control tests and inspections conducted during that period. The weekly summary report shall be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all inspections, test types, test locations, testers, test results, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, and the material supplier, installer and Contractor. Re-tests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report.

- B. The weekly report shall be submitted per Sections 013000 and 013350 requirements.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 REMOVAL OF NONCONFORMING MATERIAL**

- A. The Contractor is obligated to correct or remove nonconforming materials, whether in place or not. If necessary, the DEN Project Manager will send written notification to the Contractor to correct or remove the defective materials from the project. If the Contractor fails to respond, the DEN Project Manager may order correction, removal, and/or replacement of defective materials by others, in which case the Contractor shall bear all costs incurred by such actions.

### **3.2 PERFORMANCE**

- A. If the DEN Project Manager determines that the CTA or its personnel are not effectively enforcing or performing the testing and documentation requirements specified in the Contract, the DEN Project Manager will require, in writing, the Contractor to remove and replace CTA or such personnel at no cost to DEN.

### **3.3 CONTROL OF MEASURING AND TEST EQUIPMENT**

- A. The CTA shall select measuring and test equipment in such a manner as to provide proper type, range, accuracy, calibration, and tolerance for determining compliance with specified requirements. Measuring and test devices shall be calibrated, adjusted and maintained at prescribed intervals prior to use based upon equipment stability and other conditions affecting measurement. Provisions shall be made for the proper handling and storage of equipment. Calibration shall be accomplished using certified standards that have a known traceable relationship to the National Institute of Standards and Technology. Every calibrated measuring and test device shall show the current status, date of last calibration and the due date for the next calibration. Calibration records shall be maintained onsite as quality records and shall be made available for inspection upon the DEN Project Manager's request.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.
- B. Refer to Title 17 - Inspection and Defects of the General Contract Conditions, 2011 Edition, for guidance on payment methods.

END OF SECTION **014525**

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## SECTION 014545 - SPECIAL INSPECTION AGENCY AND OWNER TESTING AGENCIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Special Inspection Statement issued as part of the application for building permit for the specific task or project.

#### 1.2 SUMMARY

- A. The City will employ the services of Special Inspection Agencies (SIA). This Section identifies the requirements for the Contractor to coordinate, facilitate, and support DEN and its agents and consultants to fulfill the requirements of Special Inspection.
  - 1. Any additional tests deemed necessary by the Building Official, Engineer of Record, Special Inspector or DEN Project Manager to assure these agencies that all material and work on the Project meet the requirements of the Contract and all applicable codes and regulations.
  - 2. Minimum Laboratory and field testing requirements to be conducted by the SIA for materials and construction on this Project are included in the Table at the end of this Section.
  - 3. All caissons and piers drilling on this Project shall be continuously inspected by Special Inspection Agency hired by DEN directly or through the Engineer of Record or its sub-consultants.
  - 4. The Contractor shall not perform any work that could cover work or material that has not passed the requirement of special inspection or require the presence of the special inspector to meet the requirements of continuous or periodic inspection.
  - 5. It is the responsibility of the Contractor to plan, coordinate all testing requirements on the project to assure no delays are occurring due to the lack of inspection or testing.
  - 6. The Contractor must allow sufficient time in the schedule to perform all required inspection and testing.
  - 7. All rework due to nonconformance, failing tests or rework to test covered work prior to proper inspection and testing shall be borne by the Contractor.
  - 8. All re-inspections and re-testing costs due to non-conformances or failing tests or revisiting to test covered or incomplete work shall be borne by the Contractor at a cost of \$100 per hour in addition to all direct and indirect costs associated with testing.
  - 9. Periodic welding inspection shall include the minimum of fitting inspection and final inspection at all times.
  - 10. Inspections and tests conducted by the SIA shall not relieve in any way the

Contractor of the Contractor's responsibility and obligation to meet all specifications and referenced standards. Employment of the SIA does not relieve the Contractor of providing the required Quality Control program.

11. When inspections or tests by the SIA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor. Reference Article 5.1 of this Section.
12. Samples will only be considered if taken at random. The Contractor shall permit representatives of the City to witness the selection of samples. Inspection or tests of items or materials that fail shall be sufficient cause to terminate further inspections/tests of the same brand, make or source of that product.
13. The Contractor is obligated to correct any item deemed deficient at no additional cost to DEN.

### 1.3 SUBMITTALS

- A. All submittals shall comply with requirements of Section 013300 "Submittals" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal requirements.

### 1.4 CONTRACTOR SUBMITTAL OF PROPOSED CONTRACTOR'S TESTING AGENCIES

- A. Projects requiring Special Inspection where the Contractor is utilizing certified shop to produce material. DEN requires that testing be performed to satisfy the certification be no less than the following: All material and workmanship meets the requirements of a Contractor Material Testing Agency.
- B. The Contractor shall employ the services of a Testing Agency for process control and acceptance by the subcontractors and suppliers or material delivery for Contractor convenience or contractual obligations with others.
- C. The Contractor's Testing Agency must be accredited agency to perform any test required to be submitted for compliance with a Contract requirement or for use of data by DEN agencies for any official use, for examples and not to grant any obligation on the DEN Project Management Team, any payment reduction factor calculation. Any dispute or requirement to recalibrate testing equipment or machine, proof of compliance of material that was installed in contrary to manufacturer recommendation, any apparent defect due to adverse weather, improper installation, incomplete material record.
- D. Contractor's testing agency must be a qualified entity that has performed testing on similar jobs in size and complexity and has been accredited by AASHTO or CCRL or an approved equal to perform the tests required in the Contract. The CTA may also provide technicians to perform the required inspections. However, inspection and testing cannot be performed simultaneously by the same technician.
- E. The Contractor shall not submit for acceptance to the DEN Project Manager any

testing agency or laboratory utilized in the design or construction document preparation or presently employed by DEN as part of DEN Quality Assurance.

- F. For consideration of acceptance, the Contractor shall submit to the DEN Project Manager the following items received from the CTA:
1. Affidavit of current accreditation from a national certification and/or accreditation program.
  2. Evidence that the CTA Laboratory is accredited to perform the testing required in the Contract Documents.
  3. Resumes and evidence of professional engineer registration and licensing in the State of Colorado for the personnel reviewing and signing test reports.
  4. Resumes and current certifications verifying that SIA management and supervisory personnel, laboratory staff, field testing technicians, and inspecting technicians are qualified in accordance with ASTM C 1077, D 3666, D 3740, and E 329 requirements to perform the Work. NICET, ACI, WAQTC, LabCAT, CDOT, NRMCA, PCA, AWS, ASNT certifications, or a degree in a related engineering field with construction field experience can demonstrate qualifications. A list summarizing all management, supervisory, laboratory, field testing, and inspection personnel assigned to the Project including the testing and/or inspection each individual will be performing, certifications held by each individual, and the expiration date of each certification.
  5. A matrix indicating each technical specification section, paragraph, quantity and type of sampling and/or testing required.
  6. Copies of all laboratory, field testing, and inspection report forms.

#### 1.5 SUBMITTAL OF REPORTS

- A. Test results shall be submitted by the Special Inspector and/or DEN Testing Agency to the DEN Project Manager after completion of inspections/tests by the SIA/OTA and prior to incorporation of the items into the Work unless the test or inspection must be done during or after installation.
- B. All field test results including but not limited to fresh concrete properties and in-place moisture-density shall be reported in legible draft form to the DEN/PMT Inspection and the Contractor Quality Control Manager immediately at the test site. Any failing test shall be reported separately to the DEN/PMT Inspector or DEN Project Manager within two (2) hours after the discovery.
- C. The Contractor's Quality Control Manager or his/her Authorized representative must keep track and official record of all tests passed, failed, or defected. The Contractor shall be fully responsible to show passing tests of all required elements. The lack of any passing test record of any required element does not waive the requirement to of testing or inspection as required by the Contract Documents and the IBC. The Contractor shall bear all costs associated with recovering missing tests including but not limited to the cost of the cost of disassembling, testing or inspecting, reassembling, and any indirect time or cost impacts of a missing required test or inspection.
- D. Typed test reports shall be provided by the testing agency to the DEN Project Manager

as specified in Part 1 of this Section Weekly Summary Reports. The test reports shall be numbered sequentially in chronological order. Individual tests shall be numbered sequentially. The reports and tests shall also be organized per specification section. All test results must be reviewed and signed by a registered licensed engineer in the State of Colorado. The signature represents that the test procedures used are in strict conformance with the applicable testing standard, the calculated data are true and accurate, the tools and equipment used were in calibration, the sample was not contaminated and the persons running the test were qualified.

- E. A plan of work and administrative procedure shall be established to assure that all test and inspections frequency required are performed and all defects are tracked and retested and re-inspected to meet all applicable specifications, codes, and standards.
- F. The Contractor shall track all tests performed on the daily reports and shall submit a statement for each phase of the Work showing all elements of Quality have been completed and all defects are addressed or scheduled to be addressed prior to covering the Work.
- G. Reports of inspections and test activities are record documents and shall be maintained in a manner that provides integrity of item identification, acceptability, and traceability. Reports shall identify the following:
  - 1. Contractor's name.
  - 2. DEN Contract number and title.
  - 3. Testing Agency name.
  - 4. Name of items inspected/tested including a physical description and, as applicable, model and make.
  - 5. Quantity of items.
  - 6. Inspection/test procedure used. If national standards are used, any deviation from these standards.
  - 7. Date the sample was taken and the date the test was made.
  - 8. Location, by coordinates, building grid or station number, of where tests and/or samplings were performed including environmental condition where applicable. Include plan drawing indicating location of test and work item sampled or tested.
  - 9. Name of inspector/tester.
  - 10. In the event the testing or sampling is a re-test or re-sampling, reference the previous respective testing or sampling report.
  - 11. Specified requirements in the Contract that the item must meet. Include reference to technical specification section and paragraphs.
  - 12. Acceptability.
  - 13. Deviations/nonconformance.
  - 14. Corrective action.
  - 15. Evaluation of results.
  - 16. All information required for the specific test as specified in the applicable ASTM standard.
  - 17. Signature of authorized evaluator.

## 1.6 WEEKLY SUMMARY REPORTS

- A. The SIA/OTA shall prepare and submit to the DEN Project Manager a weekly summary report each week that summarizes by specification section all work activities and results for the quality control tests and inspections conducted during that period.
- B. The weekly summary report shall be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all inspections, test types, test locations, testers, test results, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, and the material supplier, installer and Contractor.
- C. Re-tests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report. The SIA shall identify costs of re-testing or additional site visits required due to scheduling changes by the Contractor. A current Corrective Action Report log (CAR) shall also be included in the weekly summary report.
- D. The weekly report shall be submitted per Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" requirements.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 CORRECTION OR REMOVAL OF NONCONFORMING MATERIAL

- A. The Contractor is obligated to correct or remove nonconforming materials, whether in place or not. If necessary, the DEN Project Manager will send written notification to the Contractor to correct or remove the defective materials from the Project. If the Contractor fails to respond, the DEN Project Manager may order correction, removal, and/or replacement of defective materials by others, in which case the Contractor shall bear all costs incurred by such actions.

### 3.2 PERFORMANCE

- A. If the DEN Project Manager determines that the SIA or its personnel are not effectively enforcing or performing the testing and documentation requirements specified in the Contract, the DEN Project Manager will, state in writing, the requirement for the Contractor to remove and replace SIA or such personnel at no cost to DEN.

### 3.3 CONTROL OF MEASURING AND TEST EQUIPMENT

- A. The SIA shall select measuring and test equipment in such a manner as to provide proper type, range, accuracy, calibration, and tolerance for determining compliance with specified requirements. Measuring and test devices shall be calibrated, adjusted and maintained at prescribed intervals prior to use based upon equipment stability and other conditions affecting measurement.
- B. Provisions shall be made for the proper handling and storage of equipment. Calibration shall be accomplished using certified standards that have a known traceable relationship to the National Institute of Standards and Technology. Every calibrated measuring and test device shall show the current status, date of last calibration and the due date for the next calibration. Calibration records shall be maintained onsite as quality records and shall be made available for inspection upon the DEN Project Manager's request.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for Work under the Section. DEN Project Management Team staff will track all costs and remark the conditions and track all associated impacts for credits to the City. The contractor record of the same is only valid if signed by the DEN Project Manager or authorized representative.

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for Work under this Section.
- B. Refer to Title 17 - Inspection and Defects in the General Contract Conditions, 2011 Edition, for guidance on payment methods.

## END OF SECTION 014545



## **SECTION 015050 - MOBILIZATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Section 012910 "Schedule of Values"

#### **1.2 SUMMARY**

- A. The Work specified in this Section consists of preparatory work and operations including, but not limited to the following:
  - 1. Those necessary for the movement of personnel, equipment, supplies, and incidentals to the work site.
  - 2. For the establishment of all offices, buildings and other facilities necessary for the Work on the Project.
  - 3. For all other work and operations that must be performed or costs incurred prior to beginning work on the various Contract items on the work site.

#### **1.3 SUBMITTALS**

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Submit a Mobilization Schedule a minimum of fourteen (14) days prior to first billing for mobilization.

#### **1.4 DELIVERY**

- A. Delivery to the work site of construction tools, equipment, materials, and supplies shall be accomplished in conformance with all local governing regulations.

### **PART 2 - PRODUCTS**

#### **2.1 PRODUCTS**

- A. Provide construction tools, equipment, materials, and supplies of the type and quantities that will facilitate the timely execution of the Work.

### **PART 3 - EXECUTION**

#### 3.1 EXECUTION AND REMOVAL

- A. Provide personnel, products, construction materials, equipment, tools, and supplies at the work site at the time they are required and scheduled to be installed or utilized.

### **PART 4 - MEASUREMENT**

#### 4.1 METHOD OF MEASUREMENT

- A. Refer to Section 013210 - Schedule, for details regarding mobilization scheduling, billing, and payment.

### **PART 5 - PAYMENT**

#### 5.1 METHOD OF PAYMENT

- A. Refer to Article 1104 - Changes in the Work, Contract Price or Contract Time of the General Contract Conditions, 2011 Edition.

END OF SECTION **015050**

## SECTION 015210 - TEMPORARY FACILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 312319 "Dewatering" for disposal of ground water at Project site.
  - 3. Section 321216 "Asphalt Paving" for construction and maintenance of asphalt pavement for temporary roads and paved areas.
  - 4. Section 321313 "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

#### 1.3 DESCRIPTION

- A. The Work specified in this Section consists of furnishing, installing, operating, maintaining, and removing temporary construction barriers, enclosures, and field facilities including the Contractor's construction offices, staging areas, yards, storage areas, electrical power, telephone, water, fire protection, and sanitary service.
- B. Construction Offices, Construction Yards and Storage Areas:
  - 1. The Contractor's offices, construction yards laydown and storage areas shall be located as shown on the Contract Drawings and/or as designated by the DEN Project Manager. All construction offices, staging areas, and material storage areas are to occur within these areas.
  - 2. Any activity that is expected to result in disturbance of the ground surface equal to or greater than one acre or part of a larger project that is expected to disturb equal to or greater than one acre, is required to be identified in their Erosion Control permit. These areas include, but are not limited to, laydowns, borrow areas, stockpiles, and storage areas regardless of the location.
  - 3. All areas of ground disturbance are required to be stabilized in accordance with State, local, and airport rules and regulations prior to permit termination and/or closure of the Contract.
  - 4. The Contractor shall restore any area on DEN property that becomes

- contaminated as a result of its operations in accordance with Airport Rule and Regulation 180. Restoration shall be either to applicable standards under Federal and State law or to such other levels as may be required by the Manager of Aviation, at the Manager's sole discretion.
5. All temporary facility sites must be inspected prior to Contract closeout.
    - a. The DEN Project Manager or authorized representative shall conduct an inspection of contractor areas used during the life of the project. These areas include but are not limited to, staging areas, laydown areas, borrow areas, and contractor yards and offices.
  6. The DEN Project Manager will ensure these areas have been properly stabilized in accordance with DEN Rules and Regulations and required permits. Site must be restored to the condition in which the City initially provided to the Contractor. A representative from DEN Environmental Services shall be present during the final walk through.
  7. Contractor materials shall be managed in accordance with all applicable Environmental Regulations.
  8. Temporary facilities which the Contractor desires to locate in secondary laydown and staging areas adjacent to the Work or within the project limits are subject to approval by the DEN Project Manager. If approved, these areas must also be included as part of their erosion control permit.
  9. Access to and security of the Contractor's construction offices, yard, temporary facilities, and storage areas shall be as shown on the Contract Drawings or as specified in the Contract Special Conditions.
  10. Contractor Field Office:
    - a. The Contractor shall acquire all necessary permits for installation and construction work related to the Contractor's field office and fencing.
    - b. The Contractor shall provide, as part of the Contractor's on-site field office, a conference room for weekly meetings. Minimum size to accommodate fifteen (15) people with the currently approved schedule posted on a wall. The conference room shall have network connection with a monitor] and one (1) available telephone.
    - c. Jack the mobile office unit off its wheels and provide support. Enclose the underside of the trailer with weatherproof skirting.
    - d. Install tie downs in compliance with all applicable codes.
    - e. Provide access to the field office and easily accessible space for parking six (6) full size passenger automobiles as a minimum. Grade the field office site, access roadway, and parking area for drainage, and surface with gravel paving or crushed stone.
    - f. Water and sewer lines to the field office, if installed, shall be installed so they will not freeze.
  11. All Contractor Storage Yards must be fenced. Submit fencing plan and typical details to DEN Project Manager at least seven (7) days before planned execution for review and acceptance.
  12. In accordance with Denver Fire Department Requirements, all Temporary Facilities shall have signage that lists the following information:

- a. Company Name
- b. Contact Telephone Number
- c. Facility Address

C. Electrical Service

1. Provide lighting and power for field offices, storage facilities and other construction facilities and areas.
2. Provide power centers for electrically operated and controlled construction facilities including tools, equipment, testing equipment, interior construction lighting, heating, cooling and ventilation equipment.
3. Provide night security lighting at secured areas within construction limits at offices, storage facilities, temporary facilities and excavated areas.
4. Provide battery operated or equivalent emergency lighting facilities at construction areas where normal light failures would cause employees to be subjected to hazardous conditions. Test such facilities monthly and maintain a record of these tests for the DEN Project Manager's review.
5. Contractor shall bear all costs of temporary electric service permits, fees, and deposits required by the governing authorities, and connection charges and temporary easements including installation, maintenance, and removal of equipment.

D. Telephone/Communications Service:

1. The Contractor shall furnish, install, and maintain at least two (2) telephones in the Contractor's main field office. These phones shall be manned at all times by the Contractor's personnel or by an answering machine when personnel are not in the field office.
2. Comply with requirements of Division 26 Sections.

E. Water Service:

1. The Contractor shall make all connections and extensions required and shall make use of water in direct support of the Work. The Contractor shall install an approved Water Department tap at the City's water source prior to obtaining any water. The Contractor shall arrange and pay for its supply/distribution system from the City's point of connection. The location and alignment of the Contractor's temporary supply/distribution system must be approved by the DEN Project Manager prior to its installation. The Contractor shall leave in place all above ground and underground water distribution facilities unless otherwise directed by the DEN Project Manager.
2. The Contractor shall not use in place fire hydrants or standpipes as sources for construction water or potable water.
3. Comply with requirements of Division 22 Sections.

F. Fire Protection:

1. Furnish, install, and maintain temporary portable fire protection equipment throughout the construction period at all buildings (including the project site), maintenance shops, and fuel storage on all large construction equipment and at

- the location of any flammable materials or construction materials.
2. Comply with requirements of Division 21 Sections.

G. Sanitary Service:

1. Furnish, install, and maintain temporary sanitary facilities and services throughout the construction period.
2. Ensure that separate or single user toilets shall be provided to ensure privacy between the sexes.
3. Provide general washing facilities adequate for the number of employees.
4. Provide special washing facilities adequate for the number of employees engaged in the application of paints, coating, and other volatile or hazardous materials.

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Submit a shop drawing within five (5) days of the Notice to Proceed that shows the following:
  1. Temporary facilities equipment and materials (include manufacturer's literature).
  2. Details and layout of temporary installations including fences, roads, parking, buildings, storage areas, signage, and drainage plans.
  3. Lighting plan showing temporary lighting facilities, electrical service panel location, electrical circuit diagram, and anticipated light level on the working roadway, pathway, or construction surface.
  4. As-built description of any temporary underground utilities referenced to the Airport grid and benchmark system within five (5) days of completion of the installation.
  5. Copies of all permits for all temporary facilities.

1.5 QUALITY CONTROL

- A. Provide products for, and the execution of, the Work of this Section that will satisfy the requirements of all applicable codes. Provide products that satisfy the requirements of the applicable codes.

**PART 2 - PRODUCTS**

2.1 ELECTRICAL SERVICE

- A. Provide temporary power and lighting equipment consisting of fixtures, transformers, panel boards, groundings, lamps, switches, poles, conduits and wiring sized and capable of continuous service and having adequate capacity to ensure a complete operating system. Comply with NEMA and Division 26 requirements.

## 2.2 TELEPHONE/COMMUNICATIONS SERVICE

- A. Provide equipment that is compatible with that of the current DEN service provider and the telephone exchange to which the Contractor connects.

## 2.3 POTABLE WATER SERVICE

- A. Provide sanitary materials and equipment that satisfies the requirements of codes and regulations pertaining to temporary water systems. Bottled products may be used if those products comply with codes. Clearly label portable containers having a dispensing tap and used only for drinking water. Provide single service disposable cups and a sanitary container for dispensing cups. A trash receptacle shall be provided and maintained beside each portable water supply.
- B. If paints, coatings and other volatile or hazardous materials injurious to humans will be applied as part of the Contract, provide washing facilities with warm water of approximately 120 degrees F.

## 2.4 FIRE PROTECTION

- A. Fire extinguishers shall be UL rated and shall comply with the International Fire Code with City of Denver amendments.

## 2.5 SANITARY SERVICE

- A. Provide materials and equipment adequate for the intended purposes, which will neither create unsanitary conditions nor violate the codes applicable to temporary sanitary facilities. Enclosures for toilet and washing facilities shall be weatherproof, sight proof, ventilated and sturdy, and shall be maintained in clean conditions.
- B. Provide portable type toilet facilities that satisfy the requirements of OSHA.
- C. Provide washing facilities as needed. Furnish soap, single-service paper towels, towel dispenser, and towel receptacle.

## **PART 3 - EXECUTION**

### 3.1 ELECTRICAL SERVICE

- A. The approximate location of primary power lines is shown on the Construction Drawings. The Contractor shall locate electrical service where it will not interfere with equipment, storage spaces, traffic, and prosecution of the Work or the work of others. Installation shall present a neat and orderly appearance and shall be structurally sound. Maintain service in a manner that will ensure continuous electrical service and safe working conditions.

- B. Comply with requirements of Division 26 Sections.

### 3.2 TELEPHONE/COMMUNICATION SERVICE

- A. Install temporary telephone service in a neat and orderly manner, and make structurally and electrically sound to ensure continuous service. Modify, relocate, and extend, as work progress requires. Place conduit and cable where those products will not interfere with traffic, work areas, materials, handling equipment, storage areas, and the work of other contractors. Service lines may be aerial.

### 3.3 WATER SERVICE

- A. Install the systems in a neat and orderly manner. Make them structurally and mechanically sound. Provide continuous service. Modify, relocate, and extend the systems as the Work progresses.
- B. Comply with requirements of Division 22 Sections.
- C. Locate systems where they will be convenient to work stations, sanitary facilities, and first aid station but will not interfere with traffic, work areas, materials handling equipment, storage areas, or the work of other contractors.
- D. Provide sanitary bubbler drinking fountains if potable water service is available. Disinfect water piping before using for the potable water service.
- E. Install vacuum breakers, backflow preventers, and similar devices in a manner and location that will prevent temporary water from returning to the water mains.
- F. Do not incorporate any part of temporary water distribution system into the permanent water distribution system.

### 3.4 FIRE PROTECTION

- A. Install products in conformance with the requirements of the applicable Denver Fire Department and OSHA regulations.
  - 1. Provide functional, approved fire extinguishers that are clearly identified for fire and an accessible supply of water during the period of construction. These fire extinguishers shall remain in place until permanent fire protection systems are functional.
- B. Instruct construction personnel as to location and use of temporary fire protection equipment.
- C. Comply with requirements of Division 21 Sections.



### 3.5 SANITARY SERVICE

- A. Place temporary sanitary and washing facilities in a neat and orderly manner within the limits of the Work and convenient to the workstations. Make these facilities structurally and mechanically sound. Modify, relocate, and extend the facilities as required by progress of the Work.
- B. Service toilets at those time intervals that will minimize the accumulation of wastes and prevent creation of unsanitary conditions, but not less than once a week.
- C. The waste from the sanitary and wash facilities shall be disposed of in accordance with all applicable rules, regulations, and laws and with the least environmental impact.

### 3.6 FENCING

- A. Contact all utility service companies prior to planning fence location and post locations for certification of current utilities. Locate pothole posts planned within five (5) feet of known utilities.

### 3.7 SIGNAGE

- A. Contractor shall not provide any signage for temporary facilities without prior approval from the DEN Project Manager.

### 3.8 REMOVAL

- A. The Contractor shall locate all temporary facilities including the underground utilities so they can be completely removed without damaging permanent work or the work site of other contractors.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section.

END OF SECTION 015210

## **SECTION 015215 - FIELD OFFICES**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of furnishing, installing and maintaining a field office at the work site for the City's use.
- B. DEN shall provide field offices at the location specified by the Contract Documents.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

### **PART 4 - MEASUREMENT**

#### 4.1 METHOD OF MEASUREMENT

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

### **PART 5 - PAYMENT**

#### 5.1 PAYMENT

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

**END OF SECTION 015215**

## SECTION 015525 - TRAFFIC CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of furnishing plans and designs for traffic control and haul routes, implementing these plans with all necessary personnel and equipment. Installation may require but not be limited to signage, cones, flaggers, signal lights, lighting and temporary roads.
- B. All Work must be in conformance with the "Manual of Uniform Traffic Control Devices for Streets and Highways" (MUTCD) and CDOT Standard Plans regarding traffic control.
- C. The Contractor must coordinate the Contractor's proposed traffic control needs with the needs of other contractors on the airport construction site in writing through the DEN Project Manager.
- D. Refer to Article 805 – Protection of Street and Road System in the General Contract Conditions, 2011 Edition.

#### 1.3 QUALITY CONTROL

- A. Temporary signal work shall conform to CDOT Standard Plans and the current version of the CDOT Standard Specifications.
- B. Designate a qualified person to inspect and test traffic control devices daily and to ascertain that those devices are continuously operating, serviceable, in place, and clean.
- C. Provide certified personnel who will be responsible for design, implementation, and inspection of traffic control needs.

#### 1.4 SUBMITTALS

- A. Refer to Technical Specifications Sections 013300 "Submittals" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Submit a Traffic Control Plan (TCP) that includes, at a minimum, the following list of

items for approval before starting Work. Submit an updated TCP when necessary to modify traffic operation or undertake a construction activity that creates a different traffic pattern:

1. Traffic blockade and reductions anticipated to be caused by construction operations.
  2. Temporary detours.
  3. A Method of Handling Traffic (MHT) must be submitted and approved by the DEN Project Manager, which at a minimum will show and describe proposed location, dates, hours, and duration of detours, vehicular traffic routing, and management, traffic control devices for implementing detours and details of barricades.
- C. Submit Haul Route Plan for both on- and off-site hauls. The Haul Route Plan shall be submitted 30 days prior to hauling any permanent material. The Plan shall be updated as the Contractor's plans change.
- D. Specific Traffic Considerations: The DEN Project Manager may require the Contractor to revise the Traffic Control Plan to address traffic considerations not included in the Contractor's plan.
- E. Shutdown requests for any impact to traffic must be submitted for approval a minimum of five days before the intended shutdown. These requests will be made through the DEN Project Manager.

## **PART 2 - PRODUCTS**

### **2.1 TRAFFIC CONTROL DEVICES**

- A. Devices including signs, delineators, striping, barriers, barricades, and high-level warning devices shall conform to the latest revision of the MUTCD and the latest revision of the Colorado Department of Transportation Standard Plans.

## **PART 3 - EXECUTION**

### **3.1 TEMPORARY TRAFFIC CONTROL DEVICES**

- A. Place temporary control devices in a manner that allows for the smooth flow of traffic at the posted speed limit, limiting hazards or abrupt changes in direction.
- B. Place traffic cones or delineators as directed by the MUTCD. Operate warning lights between sunset and sunrise.
- C. Place control devices so that approaching traffic is alerted to hazards and variances to normal traffic patterns.
- D. Clean and repair damaged devices or replace them with new devices as required.

3.2 TEMPORARY TRAFFIC STRIPING AND PAVEMENT MARKINGS

- A. Full-compliance striping is required at all times per the MUTCD.
- B. Temporary signs must be replaced with permanent signing within three days per the MUTCD.

3.3 FLAGGERS

- A. Furnish flaggers where required for safety and by the MHT.

3.4 CONSTRUCTION VEHICULAR TRAFFIC

- A. Restrict construction vehicles to approved haul routes.
- B. Haul routes on the airfield must be approved by Security.

3.5 CONTROLLING VEHICULAR AND PEDESTRIAN FLOW ADJACENT TO WORK SITE

- A. Ensure that construction operations will not impede normal traffic. Where work is in the area of pedestrian or occupant activity, the Contractor shall detail a plan for managing pedestrian traffic safely. Refer to Title 8 - Protection of Persons and Property, Section 801.1 in the General Contract Conditions, 2011 Edition.

3.6 SIGNS

- A. Refer to Title 8, Article 802 - Protective Devices and Safety Precautions in the General Contract Conditions, 2011 Edition.
  - 1. The Contractor must contact the DEN Project Manager a minimum of five (5) working days in advance of construction for installation, relocation, or removal of regulatory parking signs.
- B. Coordinate and pay any expense associated with the furnishing and installation of all parking regulatory signs, such as "No Stopping Any Time," etc., at the work site.
- C. Furnish and install any necessary advance detour or guidance signing.
- D. Authorize, modify, and install regulatory parking controls and vehicle turn restrictions.
- E. Implement those traffic control modifications outside of the traffic control zone that are necessary to manage diverted traffic.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 PAYMENT

- A. Payment for Traffic Control under these schedules will be for work performed under the applicable unit price item or lump sum bid item.

END OF SECTION 015525

## SECTION 015719 - TEMPORARY ENVIRONMENTAL CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Specifications Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Title 8 - Protection of Persons and Property in the General Contract Conditions, 2011 Edition, specifically the following articles:
  - 1. Article 806 - Protection of Drainage Ways
  - 2. Article 807 - Protection of Environment
  - 3. Article 808 - Hazardous and Explosive Materials or Substances
  - 4. Article 809 - Archaeological and Historical Discoveries
- C. Denver Municipal Airport System Rules and Regulations, Part 180-Environmental Management.
- D. DEN Environmental Management System (EMS)

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of identifying, and avoiding or mitigating adverse environmental impacts to air, water, soil, and other natural resources caused by construction activities.
  - 1. The Contractor, in conducting any activity on airport property or in conducting work for an airport project not on airport property, shall comply with all applicable airport, local, state, and federal rules, regulations, statutes, laws, and orders.
  - 2. Work shall not commence on any project until all FAA approvals have been received, applicable permits have been issued and signed by permittee, and all inspection requirements have been satisfied in accordance with State and local permitting requirements.

#### 1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Within ten (10) days after Notice to Proceed on a task order, the Contractor shall submit the following if applicable, unless waived by the DEN Project Manager:
  - 1. Submittals pertaining to water quality management:

- a. Construction Activities Stormwater Discharge Permit
  - 1) City and County of Denver
    - a) Sewer Use & Drainage Permit (SUDP)
    - b) Construction Activities Stormwater Discharge Permit (CASDP)
  - 2) Colorado Department of Public Health and Environment (CDPHE) Colorado Discharge Permit System (CDPS) Authorization to Discharge (Contractor need not submit a copy of the general permit or the general permit rationale)
    - a) CDPS General Permit for Stormwater Discharges Associated with Construction Activities
    - b) CDPS General Permit for Associated with Non-Extractive Industrial Activity
    - c) CDPS General Permit for Construction Dewatering Discharges (Prior to obtaining a CDPS General Permit for Construction Dewatering Discharges permit, the Contractor shall submit a draft permit application and the final permit application for DEN review and approval PRIOR to submittal to CDPHE. The Contractor need not submit a copy of the general permit or the general permit rationale.
  - 3) Upon request the contractor shall provide the following documentation
    - a) Stormwater Management Plan (SWMP)
    - b) CASDP Inactivation Request
    - c) CDPS Notice of Termination
    - d) Permit Transfer Application
    - e) Modification Application
    - f) Discharge Monitoring Reports (DMRs)
    - g) A copy of the well permit from the state Division of Water Resources for every new well that diverts or for the monitoring of groundwater. (A draft copy of the Notice of Intent for any borehole structure filed with the state Division of Water Resources).
    - h) Section 404 related permitting (Prior to obtaining a permit issued by the US Army Corps of Engineers, the contractor shall submit a draft copy of the application and coordinate with efforts DEN Environmental Services).
  - 4) Revisions or amendments to the CASMP by the Contractor: At the completion of the Project, after final stabilization has been achieved and accepted in accordance with CASDP requirements, the Contractor shall submit a copy of the CASDP Inactivation Request.
2. Submittals pertaining to sewage holding tanks associated with buildings and trailers: For purposes of this Section, the generic term "sewage holding tank"



means “individual sewage disposal system (ISDS)”, “privy vault”, “septic tank”, or “septic system”:

- a. Draft copy of the permit application for a sewage holding tank.
  - b. Copy of the Sewer Use & Drainage Permit issued by the Denver Department of Public Works.
  - c. Copy of the ISDS permit issued by the Denver Department of Environmental Health.
3. Submittals pertaining to air quality management:
- 1) Copy of any permit issued by the CDPHE Air Pollution Control Division (APCD)
4. Submittals pertaining to storage tanks and containers:
- a. Copy of the approved application issued by the State of Colorado, Department of Labor and Employment, Division of Oil and Public Safety, for installation of petroleum, or other regulated substances, storage tanks located on airport property and used for the Project.
  - b. Copy of permits issued by the Denver Fire Department for storage tank installations, storage tank removals, and hazardous materials use/storage.
  - c. Copy of Spill Prevention, Control, and Countermeasure (SPCC) Plan for petroleum storage tanks and containers with capacity of 55 gallons of oil or greater located on airport property and used for the Project.
5. Copies of any other plans, permits, permit applications, correspondence with regulatory agencies, including violations, waste manifests, results of laboratory analyses, or other environmental documentation required for the Project not previously identified herein.

#### 1.4 RELATED DOCUMENTS

- A. Code of Federal Regulations (CFR) Publications, including, but not limited to, the following:
1. 33 CFR 323 - Permits for discharges of dredged or fill materials into waters of the United States.
  2. 40 CFR - Protection of Environment.
  3. 49 CFR 171-180 Hazardous Materials Transportation Regulations.
- B. Colorado Revised Statutes, including, but not limited to, the following:
1. Water Quality Control, Title 25, Article 8.
  2. Air Quality Control, Title 25, Article 7.
  3. Hazardous Waste, Title 25, Article 15.
  4. Noise Abatement, Title 25, Article 12.
  5. Petroleum Storage Tanks, Title 8, Article 20.5.
  6. Liquefied Petroleum Gas (LPG) Storage Tanks, Title 8, Article 20, Part 4.

7. Solid waste regulations.
- C. City and County of Denver Executive Orders, including, but not limited to, the following:
    1. Executive Order No. 115 - Required Use of Denver-Arapahoe Disposal Site (Landfill).
    2. Executive Order No. 123 - Greenprint Denver Office and Sustainability Policy.
    3. Denver Revised Municipal Code, Title II, Sections 48-44 and 48-93 - Solid Waste.
  - D. City and County of Denver Construction Sites Program.
  - E. City and County of Denver Construction Activities Stormwater Management Plans Information Guide.
  - F. Any other applicable rules, regulations, ordinances, and guidance must be followed as applicable.
  - G. Refer to Section 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
  - H. Refer to Section 017419 "Construction Waste Management" for waste management requirements

## **PART 2 - PRODUCTS**

### 2.1 PRODUCTS

- A. Products required for the Work shall meet all Environmental Requirements.
- B. At a minimum, products for erosion and sediment control must conform to the technical requirements contained in the City and County of Denver "Construction Activities Stormwater Manual" and the current version of the "Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual, Volume 3: Best Management Practices".

## **PART 3 - EXECUTION**

### 3.1 AIR POLLUTION CONTROLS

- A. The Contractor shall use appropriate control measures to comply with applicable air quality permit requirements. Additionally, the Contractor must be aware of the following procedures and techniques while conducting construction activities on DEN property.  
NOTE: Application of dust control measures should be discussed and outlined in the Dust Control Plan.

1. Apply water as needed to the construction site haul roads, disturbed surface areas and public access roads as needed to suppress dust. The use of chemical stabilizer can be requested by the Contractor. The type of stabilizer to be used and locations of use must be included in the Dust Control Plan, which must be approved by the DEN Project Manager prior to application.
2. The Contractor shall suspend all earthmoving activities if wind speed exceeds 30 mph. For purposes of this Section, the generic term "earthmoving" means clearing, grubbing, excavation, topsoil removal, backfilling, embankment work, grading, trenching, drilling, and installation of borings. Contractors are expected to check wind speeds with the airport's ramp tower to demonstrate compliance with this requirement. In addition, the Project may be shut down if two of three of the Runway Visual Range (RVR) instruments read visibility of 2,400 feet or less. The instruments are used by FAA Control Tower personnel to ensure safe aircraft operations. Costs for shutdowns due to wind velocities or RVR readings shall not be grounds for delay or extra cost claims.

B. Burning of materials is strictly prohibited on DEN property.

### 3.2 WATER POLLUTION CONTROLS

- A. The Contractor shall conduct construction activities in accordance with all applicable permit requirements. In addition, the Contractor shall comply with the following procedures and requirements while conducting activities on DEN property:
1. Water encountered during construction cannot be discharged to the stormwater system or placed onto the ground surface without a permit AND prior written approval by the DEN Project Manager. If groundwater or stormwater is anticipated to be encountered and the Contractor desires to discharge it to the stormwater system or onto the ground surface, then the Contractor must obtain an appropriate CDPS discharge permit in advance of the discharge unless this activity is specifically authorized under the CDPS Construction Stormwater Permit.
  2. If water is encountered and the Contractor desires to discharge these waters to the sanitary sewer system, then the Contractor must obtain approval from DEN Environmental Services in advance of the discharge.
  3. The Contractor shall ensure that stormwater that comes in contact with storage areas does not become impacted and discharged to the stormwater sewer system or to an impervious surface. Furthermore, any materials in storage areas shall not be stored directly on the ground. Refer to Section 264200 "Cathodic Protection" for cathodic protection requirements.
  4. The Contractor shall not operate any valves, sluice gates or other drainage appurtenances related to any DEN sewer system without the prior approval of both the DEN Project Manager and DEN Environmental Services. Any violation of this directive may result in the payment of a financial penalty by the Contractor if the State of Colorado assesses such a penalty.

### 3.3 EROSION CONTROL AND SEDIMENTATION CONTROL

- A. This Work consists of constructing, installing, maintaining and removing, if required, temporary and permanent control measures during the life of the Contract (and possibly afterward) until the Contractor achieves final stabilization of the site to prevent or minimize erosion, sedimentation, and pollution of any state waters in accordance with all Environmental Requirements.
- B. The Contractor is responsible for compliance with all requirements in accordance with the CASDP, the City and County of Denver Construction Sites Program, the approved CASMP, and CDPS-issued permits.
- C. Temporary facilities, including but not limited to storage areas, laydowns, borrow areas, and contractor offices and work yards, shall be managed in accordance with Section 015210 "Temporary Facilities".
- D. Clean soil fill may be stockpiled in any area that has been previously approved and signed off by the DEN Section Manager of Construction, Design and Planning, and Environmental Services. Soil stockpiles are considered a potential pollutant source and must be addressed in the CASMP and/or SWMP.
- E. Make immediately available, upon the DEN Project Managers request, all labor, material, and equipment judged appropriate by the DEN Project Manager to maintain suitable erosion and sediment control features. These actions requested by the DEN Project Manager take precedence over all other aspects of project construction that have need of the same labor, material and equipment, except those aspects required to prevent loss of life or severe property damage.

### 3.4 CONSTRUCTION OF CONTROL MEASURES FOR EROSION AND SEDIMENTATION

- A. The Contractor must install control measures in accordance with the most recent version of the "Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual, Volume 3: Best Management Practices and the City and County of Denver Construction Activities Stormwater Manual".
  - 1. Deviations from these two documents are allowed with written consent from the City and County of Denver NPDES Inspector.

### 3.5 STORAGE OF OIL, FUELS, OR HAZARDOUS SUBSTANCES

- A. The Contractor shall prevent oil or other hazardous substances, as defined in federal and state regulations, from entering the ground, drainage or local bodies of water, and shall provide containment, diversionary structures, or equipment to prevent discharged oil from reaching a watercourse and take immediate action to contain and clean up any spill of oily substances, petroleum products, or hazardous substances. The Contractor shall provide one or more of the following preventive systems at each petroleum storage site:

1. Dikes, berms, or retaining walls capable of containing at least 100% of the volume of the largest single tank and equipped with sufficient freeboard to contain precipitation events. The secondary containment must be “sufficiently impermeable” to prevent a release to the environment.
  2. Culverting, curbing, guttering, or other similar structures capable of containing at least 100% of the volume of the largest single tank and freeboarding from precipitation.
- B. The provision of such preventive systems shall be subject to acceptance by the DEN Project Manager prior to tank installation and shall follow the SPCC regulations (40 CFR Part 112).
- C. Prior to bringing any containers of 55-gallon or above capacity onto DEN property for storage of oil, fuel, or other petroleum substances, the Contractor may be required to prepare an SPCC Plan that conforms to 40 CFR Part 112. The plan must include a certification either from a Professional Engineer or self-certification, if applicable, as well as management approval from the legally responsible Contractor representative.

### 3.6 SPILL RESPONSE AND NOTIFICATION

- A. The Contractor is responsible for all spills that may result from its activities. For ANY suspected or confirmed release or spill of oil, fuel, solid waste, hazardous waste, unknown materials, lavatory waste, or miscellaneous chemicals, etc., that occurs as the result of the Contractor’s activities on DEN property, the Contractor is required to take immediate action to mitigate the release or spill and report it to the DEN Project Manager and to the DEN Communications Center at (303) 342-4200.
- B. The Contractor is responsible for notifying the appropriate regulatory agency in the event suspected and/or confirmed releases are identified, in accordance with regulatory requirements.

### 3.7 SITE REMEDIATION AND RESTORATION

- A. The Contractor shall be required to perform any necessary site assessment and remediation activities required by applicable regulatory agency.
- B. During routine construction activities, the Contractor is required to manage soils using typical construction techniques. The Contractor must differentiate between soils and wastes, including contaminated soils versus clean soils, and determine those materials that can remain on DEN property and those that must be transported off site for disposal.
- C. During all construction activities that require the management of soils, the Contractor must notify the DEN Project Manager and DEN Environmental Services (ES) that soils being managed may be impacted by industrial activities conducted at the airport. “Process knowledge” pertaining to previous use and/or impact for the locations under construction can be used to determine whether impacted soils are probable. Also, common indices such as soil staining and odor can be used as a determination for the

probable condition. If probable contamination conditions are suspected, the Contractor will notify the DEN Project Manager and DEN ES immediately. At that time, which may be before the Work is initiated where indicative conditions exist, all work will cease until a sampling and analysis approach is determined and implemented by the proper responder.

- D. If the site conditions warrant based on evidence of spillage or contamination, process knowledge, and/or visual or olfactory observations, the Contractor may be required to conduct sampling and analysis to confirm that no remedial action is required. Prior to conducting any removal activities, the Contractor must provide a Scope of Work to the DEN Project Manager describing the proposed site assessment activities.
- E. The impacted project will modify its operation to include a segregation area where probable impacted soils can be placed, stored, and sampled for characterization. Should the soil materials be determined to exceed the applicable standards, the DEN Project Manager, in conjunction with DEN ES, will be responsible for the proper disposal of these materials. Materials that are determined to contain contamination levels below the applicable standards can be considered clean soils and placed back into the excavation or reused elsewhere on DEN property. In accordance with Part 3 of this Section, materials removed that are suitable for recycling will be placed within areas designated on DEN to store these materials.
- F. The Contractor shall restore any area on the Airport that becomes contaminated as a result of its operations. Restoration shall be either to applicable standards under federal and state law or to such other levels as may be required by the Manager of Aviation, at the Manager's sole discretion. Such restoration shall be completed at the earliest possible time, and the Contractor's restoration shall be subject to inspection and approval by the Manager of Aviation or duly authorized representative. See DEN Rules & Regulations - Part 180.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

- A. No separate payment will be made for work under this Section.
- B. The Contractor shall be responsible for payment of all fees associated with review of environmental permit applications and processing of environmental permits.

END OF SECTION 015719

## **SECTION 015810 - TEMPORARY SIGNS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes requirements for the following:
  - 1. Construction signage visible to the public.
  - 2. Temporary directional, informational, or regulatory signage.
- B. Related Requirements:
  - 1. Section 015210 "Temporary Facilities" for requirements for temporary facilities.

#### **1.3 SUBMITTALS**

- A. Submit temporary sign finishes, materials and paint, etc., for review and approval by DEN Project Manager prior to any fabrication.

#### **1.4 QUALITY CONTROL**

- A. Construction and other temporary signage visible to the public must be commercial grade quality, professionally fabricated, and installed based on the location of the sign. The Contractor is responsible to maintain this signage until it is no longer needed, and to remove signage from the site.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Interior signs that are visible and not physically accessible to the public may be made of rigid board, such as "Gator Board", with vinyl messages. All edges must be finished and all fasteners concealed.
- B. Interior signs that are visible and physically accessible by the public must be vandal-proof. Acceptable examples of vandal-proof signs are messages applied second surface with concealed tamperproof fasteners.

- C. Exterior signs must be vandal-proof and fabricated of weatherproof materials.

### **PART 3 - EXECUTION**

#### **3.1 HARDWARE**

- A. Interior Signs: Attach with suitable adhesive and/or tape which may be removed without damage to finishes.
- B. Exterior Signs: Must be secured to withstand site conditions and varying weather conditions.

#### **3.2 SIGN FINISHES, MATERIALS, AND PAINT**

- A. Provide temporary signage to reflect permanent sign design and/or as directed by the DEN Signage Design Project Manager. Submit temporary sign finishes, materials and paint, etc., for review and approval prior to any fabrication.

#### **3.3 MAINTENANCE**

- A. The Contractor shall maintain temporary signage until it is no longer needed, as determined by DEN Project Manager.

#### **3.4 REMOVAL**

- A. The Contractor shall remove all temporary signs, and clean and refurbish affected areas to their original, or intended, condition.

### **PART 4 - MEASUREMENT**

#### **4.1 METHOD OF MEASUREMENT**

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

### **PART 5 - PAYMENT**

#### **5.1 METHOD OF PAYMENT**

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



## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012300 "Alternates" for products selected under an alternate.
  - 2. Section 012510 "Substitutions" for requests for substitutions.
  - 3. Section 014225 "Reference Standards" for applicable industry standards for products specified.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

#### 1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number, title, and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  2. DEN Project manager's Action: If necessary, DEN Project Manager will request additional information or documentation for evaluation within one week of receipt of a comparable product request. DEN Project Manager will notify Contractor] of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
    - b. Use product specified if DEN Project Manager does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  2. If a dispute arises between contractors over concurrently selectable but incompatible products, DEN Project Manager will determine which products shall be used.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and

- instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Refer to Title 18 - Warranties, Guarantees and Corrective Work of the General Contract Conditions, 2011 Edition.
- B. Submittal Time: Comply with requirements in Section 017720 "Contract Closeout."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, and unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," DEN Project Manager will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
  - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience [**will**] [**will not**] be considered[ **unless otherwise indicated**].
  - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
  - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience [**will**] be considered unless otherwise indicated.
  - b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match DEN Project Manager's sample", provide a product that complies with requirements and matches DEN Project Manager's sample. DEN Project Manager's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012510 "Substitutions" for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by DEN Project Manager from manufacturer's full range" or similar phrase, select a product that complies with requirements. DEN Project Manager will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: DEN Project Manager will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, DEN Project Manager may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

## 2.3 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations," Section 018113.16 "Sustainable Design Requirements - LEED for Commercial Interiors," Section 018113.19 "Sustainable Design Requirements - LEED for Core and Shell Development."
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to DEN Project Manager for the visual and functional performance of in-place materials.

**PART 3 - EXECUTION (Not Used)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **016000**

## **SECTION 016610 - STORAGE AND PROTECTION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. The Work specified in this Section consists of providing storage and protection of the materials, products and supplies which are to be incorporated into the construction and indicating such storage areas on the working drawings with the location and dates when such areas will be available for each purpose.
- B. Related Requirements:
  - 1. Section 015210 "Temporary Facilities" for requirements for temporary facilities.

#### **1.3 SUBMITTALS**

- A. Refer to Technical Specifications Sections 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures. Submit concurrently with submittals required in Section 013223 "Construction Layout, As-built and Quantity Surveys".
- B. Submit working drawings showing locations of storage areas not indicated on the Contract Drawings.
- C. Submit descriptions of proposed methods and locations for storing and protecting products.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Materials required for the storage and protection of the items specified shall be durable, weatherproof and either factory finished or painted to present an appearance acceptable to the DEN Project Manager and the City. Storage facilities shall be uniform in appearance with similar materials used to the maximum extent possible.

## **PART 3 - EXECUTION**

### **3.1 GENERAL REQUIREMENTS OF EXECUTION**

- A. Palletize materials, products, and supplies that are to be incorporated into the construction and stored off the ground. Material and equipment shall be stored only in those areas that are indicated as storage areas on the Contract Drawings and on the reviewed and accepted working drawings.
  - 1. Store these items in a manner which will prevent damage and which will facilitate inspection.
  - 2. Leave seals, tags, and labels intact and legible.
  - 3. Maintain access to products to allow inspection.
  - 4. Protect products that would be affected by adverse environmental conditions.
- B. Periodically inspect stored products to ensure that products are being stored as stipulated and that they are free from damage and deterioration.
  - 1. Any damaged or deteriorated materials must be replaced immediately to avoid delays in the project schedule.
- C. Do not remove items from storage until they are to be incorporated into the Work.
- D. The Contractor shall ensure that all protective wrappings and coverings are secure and ballasted to prevent any items from deterioration and/or subsequent dislodgment. All items on the work site that are subject to becoming windborne shall be ballasted or anchored.

### **3.2 HANDLING AND TRANSPORTATION**

- A. Handling:
  - 1. Avoid bending, scraping, or overstressing products. Protect projecting parts by blocking with wood, by providing bracing or by other approved methods.
  - 2. Protect products from soiling and moisture by wrapping or by other approved means.
  - 3. Package small parts in containers such as boxes, crates, or barrels to avoid dispersal and loss. Firmly secure an itemized list and description of contents to each container.
- B. Transportation:
  - 1. Conduct the loading, transporting, unloading, and storage of products so that they are kept clean and free from damage.

### **3.3 STORAGE**

- A. Store items in a manner that shall prevent damage to the DEN's property. Do not store



hydraulic fluids, gasoline, liquid petroleum, gases, explosives, diesel fuel, and other flammables in excavations. Petroleum products and chemicals must be stored in closed containers within secondary containment.

- B. Provide sheltered weather-tight or heated weather-tight storage as required for products subject to weather damage.
- C. Provide blocking, platforms or skids for products subject to damage by contact with the ground.
- D. All material shall be stored according to the manufacturer's recommendations. Any material that has to be stored within specified temperature or humidity ranges shall have a 24-hour continuously written recording made of the applicable condition. Should the recording show that the material was not stored within the recommended ranges the material shall be considered defective and in nonconformance. If a certification from the manufacturer's engineering design representative is provided stating that the actual variations are acceptable and will in no way harm the material or affect warranties, then the deficiency will be considered corrected.
- E. Store hazardous material separately, with all material marked with a label showing the hazard and how to treat exposure to the material. Store incompatible materials separately.
- F. Extra materials that are left over at the completion of the Work shall be removed from the Project site by the Contractor unless they are required to be delivered to DEN as per Contract Document requirements for maintenance stock.

### 3.4 LABELS

- A. Storage cabinets and sheds that will contain flammable substances and explosive substances shall be labeled "FLAMMABLE - KEEP FIRE AWAY" and "NO SMOKING" with conspicuous, bold lettering and conforming to OSHA requirements. Flammable substances shall be stored in flammable storage cabinets that conform to OSHA requirements.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

- A. The cost of the Work described in this Section shall be included in the applicable unit

price item, work order, or lump sum bid item.

- B. Reference Section 012910 "Schedule of Values" for additional requirements for the possible payment of stored material.

END OF SECTION 016610

## SECTION 017330 - CUTTING AND PATCHING

### PART 1 - GENERAL

- A. RELATED DOCUMENTS
- B. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- C. Refer to Article 316, Cutting and Patching the Work in the General Contract Conditions, 2011 Edition

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Phased construction.
  - 4. Work by DEN.
  - 5. Work under separate contracts.
  - 6. Future work.
  - 7. Purchase contracts.
  - 8. DEN-furnished products.
  - 9. Contractor-furnished, DEN-installed products.
  - 10. Access to site.
  - 11. Coordination with occupants.
  - 12. Work restrictions.
  - 13. Specification and drawing conventions.
  - 14. Miscellaneous provisions.
- B. Related Requirements:
  - 1. Section 015210 "Temporary Facilities" for limitations and procedures governing temporary use of DEN's facilities.
  - 2. Section 015719 "Temporary Environmental Controls" for environmental control requirements.
  - 3. Section 024119 "Selective Demolition" for selective demolition of structures and other elements.
  - 4. Section 099123 "Interior Painting" for interior painting of areas of cutting and patching.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

### 1.3 DEFINITIONS

- A. Cutting: Removal of existing construction to permit installation of or to perform other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

### 1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Cutting and Patching Proposal: Submit a proposal describing procedures at least thirty (30) calendar days before the time cutting and patching will be performed, requesting approval to proceed. Obtain approval of cutting and patching proposal by DEN Project Manager before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work. The proposal shall include at least the following information:
  - 1. Identification of the Contract and the Contractor's name.
  - 2. Description of proposed work:
    - a. Scope of cutting, patching, alteration, or excavation.
    - b. The necessity for cutting or alteration.
    - c. Drawing showing location of the requested cutting or alteration, along with radar or x-ray report.
    - d. Trades that will execute the work.
    - e. Products proposed to be used.
    - f. Extent of refinishing to be done.
    - g. Alternatives to cutting and patching.
  - 3. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
  - 4. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted and proposed dates of interruption of service. Additionally, verify and locate anything in or behind the area prior to cutting.
  - 5. Proposed Dust Control and Noise Control Measures: Submit a statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
  - 6. Effect on the work and other surrounding work or on structural or weatherproof integrity of Project.
  - 7. Written concurrence of each contractor or entity whose work will be affected.
  - 8. Cost proposal, when applicable.

## 1.5 QUALITY CONTROL

- A. Operational Elements: Do not cut and patch ANY operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance, decreased operational life or safety unless approved by the DEN Project Manager. Operations elements may include, but are not limited to the following:
1. Primary operational systems and equipment.
  2. Air or smoke barriers.
  3. Fire protection systems.
  4. Control systems.
  5. Communication systems.
  6. Conveying systems.
  7. Electrical wiring systems.
  8. Operating systems of special construction as described in Divisions 13 and 26.
  9. HVAC systems.
- B. Miscellaneous Elements: Do not cut and patch ANY of the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or those results in increased maintenance, decreased operational life or safety unless approved by the DEN Project Manager. Miscellaneous elements may include, but are not limited to the following:
1. Water, moisture, or vapor barriers.
  2. Membranes and flashings.
  3. Exterior curtain wall construction.
  4. Equipment supports.
  5. Piping, ductwork, vessels and equipment.
  6. Noise control and vibration control elements and systems.
  7. Stud walls.
  8. Roofing system
- C. Visual Elements: Do not cut and patch ANY construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would reduce, in DEN's sole opinion, the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactorily manner.
1. If possible, retain the original installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage the original installer or fabricator, engage another recognized, experienced, and specialized firm as approved by the DEN Project Manager. Visual elements may include, but are not limited to:
    - a. Stonework and stone masonry.
    - b. Ornamental metal.
    - c. Matched-veneer woodwork.
    - d. Preformed metal panels.
    - e. Firestopping.
    - f. Window wall systems.

- g. Terrazzo.
- h. Flooring.
- i. Wall coverings and finishes.
- j. HVAC enclosures, cabinets, or covers.

- D. Cutting and Patching Conference: Before proceeding, meet at the Project site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch and repair materials and surfaces cut or damaged during cutting and patching operations by methods and with materials so as not to void existing warranties.

1. All effort shall be made to engage the original installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage the original installer or fabricator, engage another recognized, experienced and specialized firm as approved by the DEN Project Manager:

- a. Processed concrete finishes.
- b. Stonework and stone masonry.
- c. Ornamental metal.
- d. Matched-veneer woodwork.
- e. Preformed metal panels.
- f. Firestopping.
- g. Window wall systems.
- h. Terrazzo.
- i. Flooring.
- j. Wall coverings and finishes.
- k. HVAC enclosures, cabinets, or covers.

## 1.7 MATERIALS

- A. General: All patching material shall be of the type specified for the material being patched. Comply with requirements specified in other specifications Sections.

- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually and texturally match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials as approved by the DEN Project Manager.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers. Provide additional substrates or materials if required to achieve desired final results of patching work.
  - 2. Immediately notify the DEN Project Manager, in writing, of unsuitable, unsafe, or unsatisfactory conditions.
  - 3. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
  - 4. Proceed with patching only after construction operations requiring cutting are complete and inspected by the DEN Project Manager.

### **3.2 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut to ensure structural value or integrity.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid or minimize interruption of services to occupied areas. Do not interrupt services in without approval from the appropriate authority. Refer to the appropriate Shutdown specification/procedures for applicable services.

### **3.3 POLLUTION CONTROLS**

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations. Reference Section 015719 "Temporary Environmental Controls" for requirements.
  - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions such as ice, flooding, and pollution.

2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosures. Vacuum carpeted areas. Professionally clean carpeted areas if required.
  3. For outdoor concrete saw cutting operations, slurry waste must be vacuumed up immediately to prevent migration off-site to pervious surfaces, surface waters or drains.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Concrete slurry waste must be disposed of properly in accordance with applicable airport, local and state rules and regulations.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to the condition existing before selective demolition operations began.

### 3.4 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Execute cutting and demolition by methods that will prevent damage to other work and will provide a proper surface to receive patching.
1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
  2. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerance, and finishes.
  3. Restore work that has been cut or removed; install new products to provide complete work in accordance with requirements of the Contract Documents.
  4. Fit work airtight and fire safe to pipes, sleeves, ducts, conduit, and other penetrations through surfaces as required by the Contract Documents.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and other similar operations, including excavation, using methods least likely to damage elements retained to adjoining construction. If possible, review proposed procedures with original installer and comply with original installer's written recommendations.
1. In general, use ground fault hand or small power tools designed (to short if metal is hit) for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete: Use a cutting machine such as an abrasive saw or a diamond-core drill.
  4. Proceed with patching after construction operations requiring cutting are complete.



- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other specification Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing. For continuous surfaces, refinish entire unit to the nearest break line. For an assembly, refinish entire unit.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs on a painted surface, apply primer and intermediate paint coats over the patch and apply the final coat over the entire unbroken surface containing the patch. Provide additional coats until the patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
- D. Fire Rated Construction: Where rated elements are cut, reconstruct to approved designs to provide original fire rating.

### 3.5 CORE DRILLING

- A. The Contractor shall execute a minimum of x-rays or ground penetrating radar (GPR) at each location planned for core drilling prior to submittal to the DEN Project Manager and to utility representatives for approval for core drilling. The request for approval shall be submitted a minimum seven (7) days before Core Drilling. The request for approval shall indicate on the x-ray or radar information regarding alternate locations or core drilling to avoid structural members and any embedded conduit. Embedded conduit may be metallic or plastic. The x-ray or radar system shall be capable of detecting both types of conduit.
- B. Core drilled “cores” and the core-drilled opening shall be inspected by DEN Project Manager Representatives prior to installation of any systems in new openings.
- C. The request for approval shall indicate on the x-ray or radar information regarding alternate locations or core drilling to avoid structural members and any embedded conduit. Embedded conduit may be metallic or plastic. The x-ray or radar system shall be capable of detecting both types of conduit.
- D. X-ray activities may not be performed during hours of activity or occupancy in the area of the x-ray system. The Contractor shall provide all manpower and barriers required

to secure the areas affected by x-ray activities.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 017330

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section describes the requirements for the disposal, recovery, reuse or recycling of non-hazardous and non-asbestos containing construction and demolition waste for both LEED and non-LEED projects. Note that LEED projects may have more specific requirements than identified in this section.
- B. Waste materials shall be managed in accordance with all local, state, and federal regulations.
- C. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submittal procedures.
  - 2. Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
  - 3. Section 015719 "Temporary Environmental Controls" for environmental control procedures.
  - 4. Section 018113 "Sustainable LEED Requirements" for LEED requirements.
  - 5. Section 024116 "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements[, and for disposition of hazardous waste].
  - 6. Section 024119 "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements[, and for disposition of hazardous waste].
  - 7. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
  - 8. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### 1.3 DEFINITIONS

- A. Solid Waste: means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, air pollution control facility, or other discarded material; including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations, commercial operations or community activities. Solid waste does not include any solid or dissolved materials in domestic sewage, or agricultural wastes, or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under the provisions of the "Colorado Water

Quality Control Act", Title 25, Article 8, CRS or materials handled at facilities licensed pursuant to the provisions on "Radiation Control Act" in Title 25, Article 11, CRS. Solid waste does not include:

1. Materials handled at facilities licensed pursuant to the provisions on radiation control in Article 11 of Title 25, C.R.S.
2. Excluded scrap metal that is being recycled.
3. Shredded circuit boards that are being recycled.

B. Salvaged Materials: Defined as materials that exist on the site that can be reused, either on site or by another entity

C. Recyclable Materials: Defined as materials that exist on site or are generated during the construction process that can be recycled and/or remanufactured into another material. Recyclable waste includes, but is not limited to, the following:

1. Concrete.
2. Asphalt
3. Ferrous and non-ferrous metals.
4. Untreated wood, engineered wood.
5. Gypsum wallboard.
6. Corrugated cardboard, paper goods.
7. Plastic.
8. Glass, insulation.
9. Carpet.
10. Paints, fabric.
11. Rubber.
12. Stone and brick.

D. Hazardous Waste: Per 6 CCR 1007-3, those substances and materials defined or classified as such by the Hazardous Waste Commission pursuant to 25-15-302, C.R.S., as amended. Also, see hazardous waste definition per 40 CFR 261.3.

E. Asbestos Containing Materials: Per 5 CCR 1001-10: Regulation No. 8, The Control of Hazardous Air Pollutants, Part B The Control of Asbestos- material containing more than 1% asbestos

#### 1.4 SUBMITTALS

A. The Contractor shall submit a list of materials and products used with Safety Data Sheets (SDS). Examples include chemicals, solvents, fuels, building materials, etc.

1. A hardcopy or electronic link to the SDS for all materials and products used, if applicable.
2. Identify storage methods for materials, including measures to segregate incompatible materials.

B. The Contractor shall submit a Waste Management Plan to the DEN Project Manager and DEN Environmental Services. Minimum Waste Management Plan requirements

include the following:

1. A list of all waste streams generated by the project
    - a. For each waste stream listed, the Contractor shall identify the handling/transportation method, the disposal method, and the disposal facility utilized.
    - b. If the Contractor anticipates generation of hazardous waste, the Contractor shall provide its USEPA (generator) identification number.
  2. Pollution Prevention Measures
    - a. Describe best practices that will reduce waste. For example, waste reduction measures, requiring vendors to deliver materials in reusable packaging, etc.
  3. Waste Management Plan Training.
  4. Storage of materials.
  5. Spill response.
- C. Approval of Contractor's Waste Management Plan does not relieve the contractor of responsibility for compliance with applicable environmental regulations.
1. The contractor shall maintain a record of the amounts of construction and demolition waste generated, recycled, reused, salvaged, or disposed of, in pounds for review.
  2. Hauling manifest records shall be maintained and available for review. Manifest forms are available from the DEN Project Manager

## **PART 2 - PRODUCTS**

- 2.1 A list of all materials and products used. Examples include chemicals, solvents, solvents, fuels, curing compounds, etc.
- A. A hardcopy or electronic link to SDSs for all materials and products used.
  - B. Identify storage methods, including measures to segregate incompatible materials.
  - C. Refer to the Waste Management Plan

## **PART 3 - EXECUTION**

- A. The Contractor shall not wash down equipment in such a manner as to flush grease, oils, detergents, and other contaminants onto the project site or onto airport property unless the waste is properly contained, treated, and disposed of.
- B. DEN maintains two dry concrete and asphalt recycling yards used for the accumulation and crushing of asphalt and concrete. The South Yard is located on 71st Ave just east

of Jackson Gap Street. The North Yard is located on the south side of 110th, west of Queensburg Street.

- C. Concrete washwater cannot be discharged to surface waters or to storm sewer systems. Colorado Discharge Permit System (CDPS) coverage conditionally authorizes discharges to the ground of concrete wash water from washing of tools and concrete mixer chutes when appropriate best management practices (BMPs) are implemented.
1. A bermed containment area that allows discharge water to infiltrate or evaporate;
    - a. Alternatives to bermed containment areas include portable concrete washout bins, and industrial washout containment systems where the accumulated waste is removed from the site and disposed of properly.
  2. Use of the washout site should be temporary (less than one year);
  3. The washout site should not be located in an area where shallow groundwater may be present, such as near natural drainages, springs, or wetlands
  4. Upon termination of the washout site, accumulated solid waste, which includes concrete waste and contaminated soils, must be removed from the site and disposed of properly.
- D. Rejected loads and/or other wet concrete or asphalt materials are PROHIBITED TO BE PLACED ANYWHERE on DEN property. These materials must be returned to the facility of origination or other permitted facility for proper disposal.
- E. Concrete saw cutting slurry must be properly contained and disposed of.
- F. Unknown or questionable materials encountered during construction activities, must immediately be reported to the DEN Communications Center at (303) 342-4200 and the DEN Project Manager.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

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

END OF SECTION 017419

## SECTION 017420 - CLEANING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this section consists of maintaining a clean, orderly, hazard free work site during construction, and final cleaning for the City's Final Acceptance. Failure to maintain the work site will be grounds for withholding monthly payments until corrected to the satisfaction of the DEN Project Manager.
- B. Refer to Article 325, Cleanup During Construction in the General Contract Conditions, 2011 Edition

#### 1.3 JOB CONDITIONS

- A. Safety Requirements

- 1. Maintain the work site in a neat, orderly, and hazard-free manner in conformance with all federal, state, and local rules, codes, regulations, and orders, including all OSHA requirements, until Final Acceptance of the Work. Keep catwalks, underground structures, work site walks, sidewalks, roadways, and streets, along with public and private walkways adjacent to the work site, free from hazards caused by construction activities. Inspect those facilities regularly for hazardous conditions caused by construction activities.

- B. Hazards Control:

- 1. Store waste materials in properly labeled waste containers. This includes solid wastes, hazardous wastes, universal wastes, etc.
- 2. Store volatile wastes in covered metal containers and remove those wastes from work site daily.
- 3. Do not accumulate wastes that create hazardous conditions.
- 4. If volatile and noxious substances are being used in spaces that are not naturally ventilated adequately, provide artificial ventilation.
- 5. Hazard controls shall conform to the applicable federal, state, and local rules and regulations.
- 6. Provide appropriate waste receptacles in all areas in which employees are working. Waste receptacles shall be kept covered at all times. All materials on site shall be anchored and covered to prevent any objects from becoming wind-borne.

C. Access:

1. Maintain the work site to permit access by other City contractors as required and to allow access by emergency personnel.

1.4 SUBMITTALS

A. Washing Plan: The Contractor shall prepare a plan describing the specific procedures and materials to be utilized for any equipment, vehicle, etc., washing activities. The plan must be submitted to the DEN Project Manager and approved by the DEN Project Manager and Environmental Services.

1. Outdoor washing at DEN is not allowed unless the materials will be collected or managed in a manner to ensure that they will not enter the municipally owned separate storm sewer system (MS4). The materials can only be disposed at a location pre-approved by DEN Environmental Services (refer to DEN SWMP). Failure to comply with this requirement would result in the discharge of non-stormwater.
  - a. Outdoor wash materials that contain soaps or other cleaning chemicals must be collected and disposed of off site
2. Indoor washing must be conducted in accordance with the Best Management Practices (BMPs) detailed in the DEN SWMP. Refer to Section 015719 "Environmental Controls". In addition, all indoor washing must be conducted in a manner that ensures that there are no prohibited discharges to the sanitary sewer system.
  - a. All wash-water that will be disposed of into the sanitary sewer must comply with City and County Denver rules and regulations pertaining to prohibited discharges.

**PART 2 - PRODUCTS**

2.1 CLEANING MATERIALS

- A. Utilize the type of cleaning materials recommended by the manufacturer for the surfaces to be cleaned.
- B. Maintain current Safety Data Sheets (SDS) on site for all chemicals. DEN Environmental Services must approve the chemicals used prior to discharge to the sanitary sewer system.
- C. Ensure proper disposal of all wastes generated from the use of these materials. The Contractor must ensure compliance with all environmental regulations. No wastes can be disposed of on DEN property.



## **PART 3 - EXECUTION**

### **3.1 INTERIM CLEANING**

- A. Clean the work site every shift/workday for the duration of the construction Contract. Maintain structures, grounds, storage areas and other areas of work site, including public and private properties immediately adjacent to work site, free from accumulations of waste materials caused by construction operations. Place waste materials in covered metal containers. All hard concrete, steel, wood, and finished walking surfaces shall be swept clean daily.
- B. Remove or secure loose material on open decks and on other exposed surfaces at the end of each workday or more often in a manner that will maintain the work site hazard free. Secure material in a manner that will prevent dislodgment by wind and other forces.
- C. Sprinkle waste materials with water or acceptable chemical palliative to prevent blowing of dust.
- D. Promptly empty waste containers when they become full and legally dispose of the contents at dumping areas off the City's property.
- E. Control the handling of waste materials. Do not permit materials to be dropped or thrown from structures.
- F. Immediately remove spillage of construction related materials from haul routes, work site, private property, public rights of way, or on the Denver International Airport site.
- G. Clean only when dust and other contaminants will not precipitate upon newly painted surfaces.
- H. Cleaning shall be done in accordance with manufacturer's recommendation.
- I. Cleaning shall be done in a manner and using such materials as to not damage the Work.
- J. Clean areas prior to painting or applying adhesive.
- K. Clean all heating and cooling systems prior to operations. If the Contractor is allowed to use the heating and cooling system, it shall be cleaned prior to testing.
- L. Clean all areas that will be concealed prior to concealment.
- M. Dispose of all fluids according to the approved Washing Plan.

### **3.2 FINAL CLEANING**

- A. Refer to Article, Clean-up Upon Completion in the General Contract Conditions, 2011 Edition. Additionally, the Contractor, shall at a minimum, complete the following:

1. Inspect interior and exterior surfaces, including concealed spaces, in preparation for completion and acceptance.
2. Remove dirt, dust, litter, corrosion, solvents, discursive paint, stains, and extraneous markings.
3. Remove surplus materials, except those materials intended for maintenance.
4. Remove all tools, appliances, equipment, and temporary facilities used in the construction.
5. Remove detachable labels and tags. File them with the manufacturer's specifications for that specific material for the City's records.
6. Repair damaged materials to the specified finish or remove and replace.
7. After all trades have completed their work and just before Final Acceptance, all catch basins, manholes, drains, strainers and filters shall be cleaned; roadway, driveways, floors, steps and walks shall be swept. Interior building areas shall be vacuum cleaned and mopped.
8. Final cleanup applies to all areas, whether previously occupied and operational or not.
9. Dispose of all fluids according to the approved Washing Plan.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION **017420**

## SECTION 017515 - SYSTEM STARTUP, TESTING AND TRAINING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Provide complete startup, testing, and operator training services to ensure operability of all systems supplied.
- B. Coordinate all start-up and testing with DEN Commissioning Authority or DEN Asset Management through the DEN Project Manager.

#### 1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures. Submit the following:
  - 1. Test procedures.
  - 2. Test reports.
  - 3. Training outline.
- B. Submit Qualification Data: For **[facilitator]** **[instructor]** **[videographer]**.
- C. Attendance Record: For each training module submit the following:
  - 1. Module title
  - 2. Module description
  - 3. Length of instruction time
  - 4. Participant names
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

- B. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required. Recordings shall be high-resolution 1080p with a minimum framerate of 60Hz
- D. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 014510 "Contractor Quality Control". Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructor's personnel, audiovisual equipment, and facilities needed to avoid delays. Ensure that students are notified at least 14 [insert other] days prior to the start of instruction.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 1.5 COORDINATION

- A. Coordinate instruction schedule with DEN's operations. Adjust schedule as required to minimize disrupting DEN's operations and to ensure availability of DEN's personnel. As required, include multiple classed to accommodate various shifts
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by DEN Project Manager.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 FIELD TESTS AND ADJUSTMENTS

- A. All electrical and mechanical equipment including the interfaces with control systems and the communication system, and all alarm and operating modes for each piece of equipment, shall be tested by the Contractor to the satisfaction of the DEN Project Manager before any facility is put into operation. Tests shall be as specified herein and shall be made to determine whether the equipment has been properly assembled, aligned and connected. Any changes, adjustments, or replacements required to make

the equipment operate as specified shall be carried out by the Contractor as part of the Work.

1. At least thirty (30) days before the time allowed in the construction schedule for commencing startup and testing procedures, the Contractor shall submit to the DEN Project Manager six (6) copies of the detailed procedures the Contractor proposes for testing and startup of all electrical and mechanical equipment. These procedures are submitted for review and acceptance by DEN.
  2. The Contractor's startup and testing procedures shall include detailed descriptions of all pre-operational hardware, electrical, mechanical and instrumentation used for testing work.
    - a. Each control device, item of electrical, mechanical and instrumentation equipment, and all control circuits shall be considered in the testing procedures which shall be designed in a logical sequence to ensure that all equipment has been properly serviced, aligned, connected, wired, calibrated and adjusted prior to operation.
    - b. Motors shall be tested in accordance with ANSI/IEEE Publication 112. The Contractor is advised that failure to observe these precautions may place the acceptability of the subject equipment in question, and the Contractor may either be required to demonstrate that the equipment has not been damaged, or replace it as determined by the DEN Project Manager.
  3. Testing procedures shall be designed to duplicate as nearly as possible all conditions of operations and shall be carefully selected to ensure that the equipment is not damaged. All filters shall be in place during startup and testing.
    - a. Once the DEN Project Manager has accepted the testing procedures, the Contractor shall provide checkout, alignment, adjustment and calibration signoff forms for each item of equipment and each system that will be used.
    - b. The Contractor and the DEN Project Manager shall use the signoff forms in the field jointly to ensure that each item of electrical, mechanical and instrumentation equipment and each system has been properly installed and tested. The Contractor shall cooperate with project-wide systems contractors where startup and testing is to be conducted concurrently.
  4. Any special equipment needed to test equipment shall be provided by the Contractor to the City at no cost for a period of thirty (30) days during startup.
- B. Before starting up the equipment, the Contractor shall properly service it and other items, which normally require service in accordance with the maintenance instructions. The Contractor shall be responsible for lubrication and maintenance of equipment and replacement filters throughout the entire equipment "break-in" period described by the manufacturer.
1. The Contractor shall be responsible for the startup, adjustment, preliminary maintenance, and checkout of all equipment and instrumentation. All systems shall be carefully checked for conformance with the design criteria.
  2. If any equipment or system does not operate as specified in the Contract, the Contractor shall immediately replace or repair components until it operates

properly.

3. The Contractor shall submit a test report to the DEN Project Manager within thirty (30) days after completion of the system startup period.

### 3.2 SYSTEMS STARTUP AND TESTING

- A. The Contractor shall be responsible for a 30-day startup period during which time all hardware, electrical and mechanical equipment, communications, alarm systems, and associated devices shall be energized and operated under local and automatic controls. The Contractor shall be present during the startup period with adequate labor and support personnel to adjust equipment and troubleshoot system failures that might arise.
- B. When a piece of electrical or mechanical equipment is found to be in conflict with specific criteria, an experienced representative of the manufacturer shall adjust the item.
- C. If adjustments fail to correct the operation of a piece of equipment or fixture, the Contractor shall remove the equipment or fixture from the Project site and replace it with a workable replacement that meets the specification requirements.
- D. The 30-day startup period shall commence thirty (30) days prior to the Contract completion date and shall be completed prior to final payment. If, during the startup, any system fails to operate in accordance with Contract requirements, the failure shall be corrected and the startup period shall begin again.
  1. At the end of the startup period, all filters shall be replaced with new ones.
  2. The City may provide, at its option, a Commissioning Representative to observe or participate in the startup and testing of any system. The Contractor shall coordinate with the Commissioning Representative relating to scheduling, reporting, forms, methods, and procedures of the startup and testing.

### 3.3 FINAL INSTRUCTIONS AND OPERATION TRAINING

- A. After startup and testing is completed, the Contractor shall demonstrate to the City's personnel the proper manner of operating the equipment, programming messages, making adjustments, responding to alarms and emergency signals, and maintaining the system.
- B. The Contractor shall provide on-the-job training by a suitably qualified instructor to designated personnel and shall instruct them in the operation and maintenance of the systems. In the event qualified instructors on the Contractor's staff are not available, the Contractor shall arrange with the equipment manufacturer for such instruction at no additional cost to the City.
- C. The Contractor shall provide a minimum of eight (8) hours of operator training to the Airport per shift. Classes shall accommodate up to five (5) people at a time with up to two (2) separate courses (one for each shift).

- D. The Contractor shall provide a syllabus to the DEN Project Manager at least seven (7) calendar days prior to the start of each course that outlines topics to be covered, the proposed time allotted to each topic, and the target audience of the training session (technical, casual operator, overview, etc.). The Contractor shall not commence any training courses until the syllabus has been reviewed and approved by the DEN Project Manager.
- E. The Contractor shall video record all training sessions and provide to the DEN Project Manager. The Contractor shall provide video recordings in format as required in Section 017900 "Demonstration and Training".
- F. The Contractor shall provide an annotated syllabus to the DEN Project Manager that indicates topics contained on each tape.
- G. The contractor shall provide instruction for obtaining live help for questions relating operation and troubleshooting

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.
- B. No contractual item requiring startup or testing will be paid until the conditions of this Section are completely satisfied.

END OF SECTION 017515

## **SECTION 017720 - CONTRACT CLOSEOUT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Work specified in this Section includes procedures required prior to Final Acceptance of the Work in addition to those specified in Title 20 – Final Completion and Acceptance of The Work in the General Contract Conditions, 2011 Edition, and Technical Specification Section 017840 "Contract Record Documents".
- B. This Section also includes procedures and penalties to ensure prompt completion of the Project Closeout.
- C. Related Sections:
  - 1. Title 20 of the General Contract Conditions, 2011 Edition..
  - 2. Section 017840 "Contract Record Documents" for required record documents.
  - 3. Form CM-75, Closeout Checklist
- D. SUBMITTALS
  - 1. Submit written Certification to the DEN Project Manager that, in the opinion of the Contractor, the Work is complete.
  - 2. Submit final survey within 60 days after issuance of Substantial Completion.
  - 3. Submit a Final Statement of Accounting to the DEN Project Manager.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION FOR FINAL INSPECTION**

- A. Before requesting inspection for Final Acceptance of the Work by the City, the Contractor shall inspect, clean, and repair the Work as required.
- B. The Contractor shall ensure that all items on the Closeout Checklist have been addressed and accepted by the DEN Project Manager.



### 3.2 FINAL INSPECTION

- A. The Contractor shall submit written certification to the DEN Project Manager when, in the opinion of the Contractor, the Work is complete. Such communication shall certify that:
1. The Work has been inspected by the Contractor for conformance with the Contract Documents.
  2. The Work has been completed in conformance with the Contract Documents, including all punchlist items.
  3. The Work is ready for final inspection by the City.
  4. All as-built documents have been submitted and accepted.
  5. All damaged or destroyed real, personal, public, or private property impacted by the Work has been repaired or replaced.
  6. All Warranties and Bonds have been completed, executed, submitted, and accepted.
  7. All personnel badges and vehicle permits have been returned to DEN Airport Security.
- B. The DEN Project Manager will inspect the Work in accordance with the Section 2002.1 of the City and County of Denver's Department of Aviation's General Contract Conditions.
- C. If the DEN Project Manager finds incomplete or defective Work:
1. The DEN Project Manager may, at the DEN Project Manager's sole discretion, either terminate the inspection, or prepare a punchlist and notify the Contractor in writing, listing the incomplete or defective Work.
  2. The Contractor shall take immediate steps to remedy all identified deficiencies and resubmit a written certification to the DEN Project Manager that Work is complete.
  3. The DEN Project Manager will then re-inspect the Work.

### 3.3 REINSPECTION FEES

- A. Should the DEN Project Manager be required to perform re-inspections of the Work due to the Contractor prematurely claiming the status of the Work to be complete:
1. The Contractor shall compensate the City for such additional services at the rate of \$125.00 per man-hour, with a minimum charge of \$250.00.
  2. The City shall deduct the amount of such compensation from the final payment to the Contractor.

### 3.4 FINAL SURVEY FEES

- A. The Contractor shall complete and submit the final survey within 60 days after issuance of Substantial Completion. If the Contractor fails to complete and submit the final survey within this time frame it is understood that DEN will arrange for a qualified

surveying company to complete this work at the Contractor's expense. All costs associated with DEN arranging for and completing the final survey will be deducted from the final payment including compensation due the City for the DEN Project Manager's time to manage this work.

1. The DEN Project Manager's rate of compensation shall be set at \$150.00 per man-hour.
2. Survey submittals needing to be revised may extend the 60-day time frame at the DEN Project Manager's discretion.
3. Costs, including the DEN Project Manager's, for the review of the resubmitted survey shall be deducted from the final payment.

### 3.5 LATE CLOSEOUT FEES

- A. Within 100 days after issuance of substantial completion, all documentation required by this Contract to achieve Project Closeout shall be submitted. Failure to submit all required documentation shall result in fees to compensate the City for project management work while the project remains open.
  1. Fees at the rate of \$450 per day.
  2. The resubmittal of required documents may extend the 100-day time frame at the DEN Project Manager's discretion.

### 3.6 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a Final Statement of Accounting to the DEN Project Manager.
- B. The Final Statement of Accounting shall reflect all adjustments to the Contract amount and shall include the following:
  1. The original Contract Value.
  2. Additions and deductions resulting from the following:
    - a. Approved Change Orders.
    - b. Allowances.
    - c. Final quantities for unit price items, including required backup for the quantities.
    - d. Deductions for corrected work.
    - e. Penalties.
    - f. Deductions for liquidated damages.
    - g. Deductions for re-inspection payments.
    - h. Other adjustments.
  3. Total Contract Value, as adjusted.
  4. Previous payments.
  5. Sum remaining due.
- C. If required, the DEN Project Manager will prepare a final Change Order, reflecting the approved adjustments to the Contract Value that were not included in previously

issued Change Orders.

### 3.7 FINAL APPLICATION FOR PAYMENT

- A. The Contractor shall submit the final application for payment in accordance with the procedures and requirements detailed in Article 2003, Final Settlement in the General Contract Conditions, 2011 Edition.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 017720

## SECTION 017825 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting operation and maintenance data for mechanical, electrical, and other specified equipment/products.
- B. Coordinate all the requirements of the required data with DEN Asset Management.

#### 1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. All submittals must be provided in electronic data as indicated by the DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and as required by the DEN BIM and DEN Asset Management groups.
- C. Submit one (1) electronic copy and three (3) bound hard copies of the proposed Operation and Maintenance Data Manual not less than [30] [90] days prior to [system startup] [acceptance tests and final inspection].
  - 1. The submitted copies shall provide the Information following the MasterFormat standard. Equipment/Data shall be organized using Section formatting within the 50 MasterFormat Divisions.
- D. Submit one (1) electronic copy and three (3) bound hard copies of Operation and Maintenance Data Manual within ten days after [system startup] [commissioning] is complete. These copies shall incorporate any comments made on the previous submittals, along with final readings on all settings and gauges taken while the system is in fully satisfactory operation.

#### 1.4 CONTINUOUS UPDATING PROGRAM

- A. Furnish to DEN AIM Asset Management one (1) electronic copy of the Contractor's letter indicating that suppliers have been notified to provide updated operation and maintenance data, service bulletins, and other information pertinent to the equipment, as it becomes available.

## PART 2 - PRODUCTS

- A. The following products are the requirements of hard copies:
1. Paper size: 8-½ inches x 11 inches.
  2. Paper: White bond, at least 20-pound weight.
  3. Text: Typewritten.
  4. Printed data: Manufacturer's catalog cuts, brochures, operation, and maintenance data. Clear reproductions thereof will be acceptable. If this data is in color, all final manuals must contain color data.
  5. Drawings: 8½ inches x 11 inches, bound with the text. Larger drawings are acceptable provided they are folded to fit into a pocket inside the rear cover of the manual. Reinforce edges of large drawings.
  6. Prints of drawings: Black ink on white paper, sharp in detail and suitable for making reproductions.
  7. Flysheets: Separate each portion of the manual with colored, neatly prepared flysheets briefly describing the contents of the ensuing portion.
  8. Covers: Provide 40 to 50 mil, clear plastic, front and plain back covers for each manual. The front covers shall contain the information required in paragraph 3.2 below.
  9. Bindings: Conceal the binding mechanism inside the manual. Lockable 3-ring binders shall be provided.
  10. Training Videos: Provide in digital electronic format as per current DEN requirements.
    - a. Refer to Section 017900 - Demonstration and Training for video requirements.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Assemble each operation and maintenance manual using the manufacturer's latest standard commercial data, and include all additional information that is unique to the Project.

### 3.2 COVER

- A. Include the following information on the front cover and on the inside cover sheet:
1. Operation and maintenance instructions.
  2. Title of structure or facility.
  3. Title and number of Contract.
  4. Contractor's name and address.
  5. General subject of the manual.

### 3.3 CONTENTS OF THE MANUAL

1. Table of Contents, which references, at a minimum, three heading levels.
2. Index of Equipment/Data with entries for equipment type and MasterFormat Division and Section.
3. A Master Index that contains index entries for all submitted Operation and Maintenance Data Manuals.
  - a. Equipment/Data shall be indexed by equipment type and MasterFormat Division and Section.
4. Name, address, and telephone numbers of Contractor, suppliers and installers along with the manufacturer's order number and description of the order.
5. Name, address, and telephone numbers of manufacturer's nearest service representatives.
6. Name, address, and telephone number of nearest parts vendor and service agency.
7. Copy of guaranties and warranties issued to, and executed in the name of, the City.
8. Anticipated date the City assumes responsibility for maintenance.
9. Description of system and component parts including theory of operation.
10. Pre operation check or inspection list.
11. Procedures for starting, operating, and stopping equipment.
12. Post operation check or shutdown list.
13. Inspection and adjustment procedures.
14. Troubleshooting and fault isolation procedures for on-site level of repair.
15. Emergency operating instructions.
16. Accepted test data.
17. Maintenance schedules and procedures.
18. Test procedures to verify the adequacy of repairs.
19. One (1) copy of each wiring diagram.
20. One (1) copy of each piping diagram.
21. Location where all measurements are to be made.
22. One (1) copy of each duct diagram.
23. One (1) copy of control diagram.
24. One (1) copy of each accepted shop drawing.
25. One (1) copy of software programs imputable or changeable on site.
26. Ordering information.
27. Training course material used to train DEN staff, including slides and other presentation material.
28. Provide the following information, unless the item is covered in the Manufacturer's Operation and Manual:
  - a. Manufacturer's parts list with catalog names, numbers, and illustrations.
  - b. A list of components that are replaceable by the City.
  - c. An exploded view of each piece of the equipment with part designations.
  - d. List of manufacturer's recommended spare parts, current prices, and recommended quantities for two years of operation.
  - e. List of special tools and test equipment required for the operation, maintenance, adjustment, testing and repair of the equipment, instruments

- and components.
- f. Scale and corrosion control procedures.
- g. Disassembly and re-assembly instructions.
- h. Troubleshooting and repair instructions.
- i. Calibration procedures.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 017825

## SECTION 017835 - WARRANTIES AND BONDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting warranties and bonds required by the Contract and these Specifications.

#### 1.3 SUBMITTALS

- A. Refer to Technical Specifications Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.

- 1. All warranties shall be executed specifically to the City.
- 2. Photocopies or reproductions of stock manufacturer's warranties will not be accepted, although electronic copies are acceptable when the manufacturer's warranty is contained in the O&M manual.

- B. Submit samples of warranties and bonds for review by the City prior to execution of Work. Do not submit final warranties until sample warranties have been approved by the City.

- 1. Submit the warranties and bonds required by the Contract Documents.
- 2. Prepare and submit a list of all warranties and bonds on the following forms:

- a. CM-10: Contractor Warranty
- b. CM-11: Contractor/Sub-Contractor Warranty

- C. Submit executed warranties and bonds



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## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 WARRANTIES AND BONDS**

- A. Submit executed warranties and bonds required by the Contract Documents, as detailed in Title 15 - Performance and Payment Bonds and Title 18 - Warranties, Guarantees, and Corrective Work in the General Contract Conditions, 2011 Edition.

1. Prepare and submit a list of all warranties and bonds on the following forms:
  - a. CM-10, Contractor Warranty
  - b. CM-11, Contractor/Sub-Contractor Warranty

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

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

END OF SECTION 017835

## SECTION 017840 - CONTRACT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. The Work specified in this Section consists of maintaining, marking, recording, and submitting Contract record documents that include shop drawings, warranties, Contract Documents, and contractor records.
- B. Refer to DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and Approved BIM execution for data format and file types acceptable for different type of data.
- C. Related Requirements:
  - 1. Section 013100 "Project Management and Coordination".
  - 2. Section 013223 "Construction Layout, As-built and Quantity Surveys".
  - 3. Section 013300 "Submittal Procedures".
  - 4. Section 013325 "Shop and Working Drawings, Product Data and Samples".
  - 5. Section 017720 "Contract Closeout".
  - 6. Section 017825 "Operation and Maintenance Data".

#### 1.3 SUBMITTALS

- A. Each submittal of record documents shall contain the following information:
  - 1. Date.
  - 2. Project title and numbers.
  - 3. Contractor's name and address.
  - 4. Title and number of each record document.
  - 5. Certification that each document as submitted is complete and accurate.
  - 6. Signature of the Contractor or the Contractor's authorized representative.
- B. At the completion of this Contract, deliver all record documents including the following:
  - 1. As-built shop drawings, diagrams, illustrations, schedules, charts, brochures and other similar data.
  - 2. Warranties, guarantees, and bonds.
  - 3. Contract Documents.
  - 4. Contractor records.

- C. As-built Contract Drawings shall be submitted with each monthly progress payment application, and a complete set shall be submitted prior to final payment.
  - 1. The Contractor shall provide a single electronic copy of each Contract drawing sheet which has been used to produce work during the payment period or work that payment is being requested on, which records the current as-built conditions of work, including the posting of any change orders or change directives not shown on the Contract Documents at the time of Contract signing.
    - a. The Contractor must show as-built work completed through the payment application date including but not limited to utilities, empty conduit, conduit for actual electrical lines, plumbing, HVAC, location of anchor bolts and support points for use by others.
    - b. The Contractor shall be liable for any costs incurred by the City or a third party due to errors or lack of information provided on the as-built drawings.
    - c. All markings on drawings shall be legible to identify the portion of work completed.
    - d. For projects utilizing BIM system by the Contractor or a consultant of the Contractor, all data formats shall be compatible and as approved by the BIM execution plan as required in the DEN BIM DSM.

#### 1.4 QUALITY CONTROL

- A. Submit electronically scanned copies of all documents required by Chapter 17 “Special Inspection and Testing” of the International Building Code 2009 as amended by City and County of Denver 2011. Keep scale and clarify dimension where electronic copies are not as originally scaled and dimensioned.
- B. For projects utilizing BIM for Revit, follow approved BIM execution plan and DEN BIM DSM for record documents, formats, and quality control and assurance procedures.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### 3.1 MAINTENANCE OF DOCUMENTS

- A. The Contractor must follow all the procedures established in the Contract Documents and DEN BIM DSM.
- B. The Contractor shall maintain at the work site on a current basis one (1) record copy of all drawings, specifications, addenda, change orders, approved shop drawings, working drawings, product data and samples in good order and marked currently to record all changes made during construction.
- C. Maintain at the field office one copy of the following record documents:

1. Contract Documents:

- a. Contract Drawings with all clarifications, requests for information, directives, changes, and as-built conditions clearly posted.
- b. Contract Specifications with all clarifications, requests for information, changes, directives and record of manufacturer actually used along with product trade name.
- c. Reference Standards in accordance with Section 014225 "Referenced Standards".
- d. Affirmative Action Plan and documents.
- e. One (1) set of drawings to record the following:
  - 1) Horizontal and vertical location of underground utilities affected by the Work.
  - 2) Location of internal utilities; include valves, controls, conduit, duct work, switches, pressure reducers, size reducers, transitions, crosses, tees, filters, motors, heaters, dampers, regulators, safety devices, sensors, access doors and appurtenances that are concealed in the construction shall be shown with dimensions given from a visible and recognizable reference to the item being located in all three dimensions. The drawings shall also reference the applicable submittal for the item being located.
  - 3) Field changes of dimensions and details including as-built elevations and location (station and offset).
  - 4) Details not on original Contract Drawings but obtained through requests for information or by other communications with the City.

2. Contractor Records:

- a. Daily Quality Control Reports.
- b. Certificates of compliance for materials used in construction.
- c. Completed inspection list.
- d. Inspection and test reports.
- e. Test procedures.
- f. Qualification of personnel.
- g. Approved submittals.
- h. Material and equipment storage records.
- i. Safety Plan
- j. Erosion, sediment, hazardous and quality plans.
- k. Hazardous material records.
- l. First report of injuries.

3.2 RECORDINGS

- A. Label each document page or article "PROJECT RECORD" in two-inch high letters.
- B. Keep record documents current daily.
- C. Legibly mark copies of the Contract Drawings to record actual construction.

- D. Legibly mark up each Section of the specifications and Contract Drawings to record:
1. Manufacturer, trade name, catalog number and supplier of each product and item actually installed
  2. Changes made by change orders, requests for information, substitutions, and variations approved by submittals.

### 3.3 DOCUMENT MAINTENANCE

- A. Follow all the required processes of the approved BIM Execution Plan as approved by DEN for this specific project or in formats acceptable to DEN BIM management system.
- B. Do not use record documents for construction purposes.
- C. Make documents available for inspection by the DEN Project Manager and any others having jurisdiction.

### 3.4 MONTHLY REVIEW

- A. Prior to any application for payment, the DEN Project Manager or the DEN Project Manager's designated representative will inspect the record documents to ensure that they are being maintained and contain the most current correct data with particular attention to as-built drawings.
- B. If, during the inspection, the DEN Project Manager determines that the documents are not being maintained and kept current as to as-built conditions, an amount may be withheld from the payment request and deducted from the Contract value to cover the City's cost of collecting and recording the as-built Contract data. This cost will be determined based on \$100.00 per man-hour of effort.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 017840



## SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing City's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training video recordings.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructor's names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator instructor videographer.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:

- a. Name of Project.
  - b. Name and address of videographer.
  - c. Name of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Date of video recording.
2. Closed Caption: Videos shall contain a visible text version of all speech provided in the recording.
  3. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
  4. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
  5. At completion of training, submit complete training manual(s) for City's use prepared and bound in format matching operation and maintenance manuals in PDF electronic file format preapproved electronic media.

## 1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A professional instructor/trainer who is experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 014510 "Contractor Quality Control". Review methods and procedures related to demonstration and training including, but not limited to, the following:
  1. Inspect and discuss locations and other facilities required for instruction.
  2. Review and finalize instruction schedule and verify availability of educational materials, instructor's personnel, audiovisual equipment, and facilities needed to avoid delays.
  3. Review required content of instruction.
  4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.



## 1.6 COORDINATION

- A. Coordinate instruction schedule with City's operations. Adjust schedule as required to minimize disrupting City's operations and to ensure availability of City's personnel.
  - 1. Include multiple classes to accommodate various shifts, as necessary.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by DEN Project Manager.

## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.

- g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.

8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017825 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

#### 3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and City for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct City's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Contractor will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. City will furnish an instructor to describe City's operational philosophy.
  3. DEN Project Manager will furnish Contractor with names and positions of DEN participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with City, through DEN Project Manager, with at a minimum of **[thirty (30)] <Insert number>** days advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of **[an oral] [a written] [a demonstration]** performance-based test.

- F. Cleanup: Collect used and leftover educational materials and [**remove from Project site**] [**give to City**]. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recordings: Submit video recordings in an electronic format acceptable to DEN Project Manager by posting to Project Web site. Recordings shall be high-resolution 1080p with a minimum framerate of 60Hz
1. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
  2. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while

dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

1. Closed Caption: Videos shall contain a visible text version of all speech provided in the recording.
  2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
  3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Failure of Video Recordings: If video recordings submitted by Contractor do not comply with Project requirements, or have audio and/or video problems, Contractor will be required to repeat training and video recording in compliance with this Section in order to re-create the training video.

#### **PART 4 - MEASUREMENT**

##### **4.1 METHOD OF MEASUREMENT**

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

#### **PART 5 - PAYMENT**

##### **5.1 METHOD OF PAYMENT**

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

END OF SECTION 017900

## SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED [ **Gold**] [ **Platinum**] certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."
  - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
  - 4. Specific requirements for LEED are included in greater detail in other Sections.

#### 1.3 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the

cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from the Architect, DIA Project Manager and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

#### 1.5 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. LEED Documentation Submittals:
  1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over [time] **[a period of time of not less than one year of postconstruction occupancy]**.
  2. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."
  3. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
  4. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material cost for each product having recycled content.
  5. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
  6. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
  7. Credit IEQ 3.1:

- a. Construction indoor-air-quality management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
8. Credit IEQ 3.2:
- a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
  - b. Product data for filtration media used during flush-out and during occupancy.
  - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
9. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
10. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
11. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
1. Furniture.
  2. Plumbing.
  3. Mechanical.
  4. Electrical.
  5. Specialty items such as elevators and equipment.
  6. Wood-based construction materials.
- C. LEED Action Plans: Provide preliminary submittals within **[seven] [14] [30] [60] <Insert number>** days of date established for **[commencement of the Work] [the Notice to Proceed] [the Notice of Award]** indicating how the following requirements will be met:
1. Credit MR 2: Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."



2. Credit MR 3: List of proposed salvaged, refurbished, and reused materials. Identify each material that will be salvaged, refurbished, or reused, including its source, cost, and replacement cost if the item was to be purchased new.
  3. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
  4. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
  5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
  6. Credit IEQ 3.1: Construction indoor-air-quality management plan.
- D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
1. Credit MR 2: Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."
  2. Credit MR 3: Salvaged, refurbished, and reused materials.
  3. Credit MR 4: Recycled content.
  4. Credit MR 5: Regional materials.
  5. Credit MR 7: Certified wood products.

## 1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

### 2.2 SALVAGED, REFURBISHED, OR REUSED MATERIALS

- A. Credit MR 3: Not less than **[5] [10]** percent of building materials (by cost) shall be salvaged, refurbished, or reused materials. The following materials may be salvaged, refurbished, or reused materials:

1. **<Insert list of materials>**.

## 2.3 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of [10] [20] percent of cost of materials used for Project.
1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  2. Do not include [furniture, ]plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

## 2.4 REGIONAL MATERIALS

- A. Credit MR 5: Not less than [10] [20] percent of building materials (by cost) shall be regional materials.

## 2.5 CERTIFIED WOOD

- A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
    - a. Rough carpentry.
    - b. Miscellaneous carpentry.
    - c. Heavy timber construction.
    - d. Wood decking.
    - e. Metal-plate-connected wood trusses.
    - f. Structural glued-laminated timber.
    - g. Finish carpentry.
    - h. Architectural woodwork.
    - i. Wood paneling.
    - j. Wood veneer wall covering.
    - k. Wood flooring.
    - l. Wood lockers.
    - m. Wood cabinets.
    - n. Furniture.

## 2.6 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: VOC not more than 50 g/L.
  2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
  3. Dry-Fog Coatings: VOC not more than 400 g/L.
  4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
  7. Pretreatment Wash Primers: VOC not more than 420 g/L.
  8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
  9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
  10. Floor Coatings: VOC not more than 100 g/L.
  11. Shellacs, Clear: VOC not more than 730 g/L.
  12. Shellacs, Pigmented: VOC not more than 550 g/L.
  13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

## PART 3 - EXECUTION

### 3.1 [REFRIGERANT] [AND] [CLEAN-AGENT FIRE-EXTINGUISHING-AGENT] REMOVAL

- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in HVAC Sections.
- B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Section 212200 "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

### 3.2 MEASUREMENT AND VERIFICATION

- A. Credit EA 5: Implement measurement and verification plan consistent with **[Option B: Energy Conservation Measure Isolation] [Option D: Calibrated Simulation, Savings Estimation Method 2]** in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:
1. **<Insert measurement and verification plan design team submitted for credit>.**

- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

### 3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."

### 3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
  - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  - 2. Replace all air filters immediately prior to occupancy.
- B. Credit IEQ 3.2:[ **Comply with one of the following requirements:**]
  - 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of **14000 cu. ft. (4 300 000 L)** of outdoor air per **sq. ft. (sq. m)** of floor area while maintaining an internal temperature of at least **60 deg F (16 deg C)** and a relative humidity no higher than 60 percent.
    - a. **<Insert operating requirements>**.
  - 2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of **3500 cu. ft. (1 070 000 L)** of outdoor air per **sq. ft. (sq. m)** of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of **0.30 cfm per sq. ft. (1.52 L/s per sq. m)** of outside air or the design minimum outside air rate determined in Prerequisite IEQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of **14000 cu. ft./sq. ft. (4 300 000 L/sq. m)** of outside air has been delivered to the space.
    - a. **<Insert operating requirements>**.
  - 3. Air-Quality Testing:

- a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."
- b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
  - 1) Formaldehyde: 27 ppb.
  - 2) Particulates (PM10): 50 micrograms/cu. m.
  - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
  - 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
  - 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
- c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
- d. Air-sample testing shall be conducted as follows:
  - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
  - 3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
  - 4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### **5.1 METHOD OF PAYMENT**

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

**END OF SECTION 018113.13**

## SECTION 018113.16 - SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR COMMERCIAL INTERIORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED[-**Certified**] [**Silver**] [**Gold**] [**Platinum**] certification based on the USGBC's "LEED 2009 for Commercial Interiors."
  - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
  - 4. Specific requirements for LEED are also included in other Sections.

#### 1.3 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
- C. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles (800 km) from Project site.



- D. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
  2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect, DIA Project Manager and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

#### 1.5 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. LEED Documentation Submittals:
1. Credit EA 3: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over [time] **[a period of time of not less than one year of postconstruction occupancy]**.
  2. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."
  3. Credit MR 3.1[ **and Credit MR 3.2**]: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
  4. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.
  5. Credit MR 5: Product data indicating location of material manufacturer for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material[ **and for each regionally extracted and manufactured material**].

- a. Include statement indicating distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials.
6. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
7. Credit IEQ 3.1:
- a. Construction indoor-air-quality management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
8. Credit IEQ 3.2:
- a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
  - b. Product data for filtration media used during flush-out and during occupancy.
  - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
9. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
10. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
11. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  1. Furniture.
  2. Plumbing.

3. Mechanical.
4. Electrical.
5. Specialty items such as elevators and equipment.
6. Wood-based construction materials.

C. LEED Action Plans: Provide preliminary submittals within **[seven] [14] [30] [60] <Insert number>** days of date established for **[commencement of the Work] [the Notice to Proceed] [the Notice of Award]** indicating how the following requirements will be met:

1. Credit MR 2: Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
2. Credit MR 3.1[ **and Credit MR 3.2**]: List of proposed salvaged, refurbished, and reused materials. Identify each material that will be salvaged, refurbished, or reused, including its source, cost, and replacement cost if the item was to be purchased new.
3. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
4. Credit MR 5: List of proposed regionally manufactured materials[ **and regionally extracted and manufactured materials**].
  - a. Identify each regionally manufactured material, including its source and cost.
  - b. Identify each regionally extracted and manufactured material, including its source and cost.
5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
6. Credit IEQ 3.1: Construction indoor-air-quality management plan.

D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2: Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."
2. Credit MR 3.1[ **and Credit MR 3.2**]: Salvaged, refurbished, and reused materials.
3. Credit MR 4: Recycled content.
4. Credit MR 5: Regionally manufactured materials[ **and regionally extracted and manufactured materials**].
5. Credit MR 7: Certified wood products.

## 1.7 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

### 2.2 SALVAGED, REFURBISHED, AND REUSED MATERIALS

- A. Credit MR 3.1[ **and Credit MR 3.2**]: Not less than **[5] [10]** percent of building materials (by cost) shall be salvaged, refurbished, or reused materials. The following materials may be salvaged, refurbished, or reused materials:

1. **<Insert list of materials>**.

### 2.3 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of **[10] [20]** percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

### 2.4 REGIONAL MATERIALS

- A. Credit MR 5, Option 1: Not less than 20 percent of materials (by cost) shall be regionally manufactured materials.
- B. Credit MR 5, Option 2: Not less than 10 percent of materials (by cost) shall be regionally extracted and manufactured materials.

### 2.5 CERTIFIED WOOD

- A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
  - a. Rough carpentry.
  - b. Miscellaneous carpentry.
  - c. Heavy timber construction.
  - d. Wood decking.
  - e. Metal-plate-connected wood trusses.
  - f. Structural glued-laminated timber.
  - g. Finish carpentry.
  - h. Architectural woodwork.
  - i. Wood paneling.
  - j. Wood veneer wall covering.
  - k. Wood flooring.
  - l. Wood lockers.
  - m. Wood cabinets.
  - n. Furniture.

## 2.6 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.

22. Plastic Cement Welding Compounds: 250 g/L.
  23. ABS Welding Compounds: 325 g/L.
  24. CPVC Welding Compounds: 490 g/L.
  25. PVC Welding Compounds: 510 g/L.
  26. Adhesive Primer for Plastic: 550 g/L.
  27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
  28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
  29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
  30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
  31. Other Adhesives: 250 g/L.
  32. Architectural Sealants: 250 g/L.
  33. Nonmembrane Roof Sealants: 300 g/L.
  34. Single-Ply Roof Membrane Sealants: 450 g/L.
  35. Other Sealants: 420 g/L.
  36. Sealant Primers for Nonporous Substrates: 250 g/L.
  37. Sealant Primers for Porous Substrates: 775 g/L.
  38. Modified Bituminous Sealant Primers: 500 g/L.
  39. Other Sealant Primers: 750 g/L.
- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: VOC not more than 50 g/L.
  2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
  3. Dry-Fog Coatings: VOC not more than 400 g/L.
  4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
  7. Pretreatment Wash Primers: VOC not more than 420 g/L.
  8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
  9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
  10. Floor Coatings: VOC not more than 100 g/L.
  11. Shellacs, Clear: VOC not more than 730 g/L.
  12. Shellacs, Pigmented: VOC not more than 550 g/L.
  13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

## **PART 3 - EXECUTION**

### **3.1 REFRIGERANT REMOVAL**

- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or

adjust existing equipment to accommodate new refrigerant as described in HVAC Sections.

### 3.2 MEASUREMENT AND VERIFICATION

- A. Credit EA 3: Implement measurement and verification plan consistent with [**Option B: Energy Conservation Measure Isolation**] [**Option D: Calibrated Simulation, Savings Estimation Method 2**] in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:
1. **<Insert measurement and verification plan design team submitted for credit>.**
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

### 3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."

### 3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  2. Replace all air filters immediately prior to occupancy.
- B. Credit IEQ 3.2: [**Comply with one of the following requirements:**]
1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of **14000 cu. ft. (4 300 000 L)** of outdoor air per **sq. ft. (sq. m)** of floor area while maintaining an internal temperature of at least **60 deg F (16 deg C)** and a relative humidity no higher than 60 percent.

- a. <Insert operating requirements>.
2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of **3500 cu. ft. (1 070 000 L)** of outdoor air per **sq. ft. (sq. m)** of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of **0.30 cfm per sq. ft. (1.52 L/s per sq. m)** of outside air or the design minimum outside air rate determined in Prerequisite IEQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of **14000 cu. ft./sq. ft. (4 300 000 L/sq. m)** of outside air has been delivered to the space.
  - a. <Insert operating requirements>.
3. Air-Quality Testing:
  - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED Reference Guide for Green Interior Design and Construction."
  - b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
    - 1) Formaldehyde: 27 ppb.
    - 2) Particulates (PM10): 50 micrograms/cu. m.
    - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
    - 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
    - 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
  - c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
  - d. Air-sample testing shall be conducted as follows:
    - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
    - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
    - 3) Number of sampling locations varies depending on the size of



- building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
- 4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

#### **PART 4 - MEASUREMENT**

##### **4.1 METHOD OF MEASUREMENT**

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

#### **PART 5 - PAYMENT**

##### **5.1 METHOD OF PAYMENT**

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

#### **END OF SECTION 018113.16**

## SECTION 018113.19 - SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR CORE AND SHELL DEVELOPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED [ **Gold**] [ **Platinum**] certification based on USGBC's "LEED 2009 for Core and Shell Development."
  - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
  - 4. Specific requirements for LEED are also included in other Sections.

#### 1.3 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the

cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect, DIA Project Manager and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

#### 1.5 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. LEED Documentation Submittals:
  1. Credit EA 5.1[ **and 5.2**]: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over [time] [**a period of time of not less than one year of postconstruction occupancy**].
  2. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."
  3. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
  4. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.
  5. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
  6. Credit MR 6: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
  7. Credit IEQ 3:

- a. Construction indoor-air-quality management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
8. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used..
  9. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
  10. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  1. Plumbing.
  2. Mechanical.
  3. Electrical.
  4. Specialty items such as elevators and equipment.
  5. Wood-based construction materials.
- C. LEED Action Plans: Provide preliminary submittals within **[seven] [14] [30] [60] <Insert number>** days of date established for **[commencement of the Work] [the Notice to Proceed] [the Notice of Award]** indicating how the following requirements will be met:
  1. Credit MR 2: Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
  2. Credit MR 3: List of proposed salvaged, refurbished, and reused materials. Identify each material that will be salvaged, refurbished, or reused, including its source, cost, and replacement cost if the item was to be purchased new.
  3. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
  4. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
  5. Credit MR 6: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
  6. Credit IEQ 3: Construction indoor-air-quality management plan.

- D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
1. Credit MR 2: Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."
  2. Credit MR 3: Salvaged, refurbished, and reused materials.
  3. Credit MR 4: Recycled content.
  4. Credit MR 5: Regional materials.
  5. Credit MR 6: Certified wood products.

## 1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

### 2.2 SALVAGED, REFURBISHED, AND REUSED MATERIALS

- A. Credit MR 3: Not less than 5 percent of building materials (by cost) shall be salvaged, refurbished, or reused materials. The following materials may be salvaged, refurbished, or reused materials:

1. **<Insert list of materials>.**

### 2.3 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of [10] [20] percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include furniture, plumbing, mechanical and electrical components, and

specialty items such as elevators and equipment in the calculation.

## 2.4 REGIONAL MATERIALS

- A. Credit MR 5: Not less than [10] [20] percent of building materials (by cost) shall be regional materials.

## 2.5 CERTIFIED WOOD

- A. Credit MR 6: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
  - a. Rough carpentry.
  - b. Miscellaneous carpentry.
  - c. Heavy timber construction.
  - d. Wood decking.
  - e. Metal-plate-connected wood trusses.
  - f. Structural glued-laminated timber.
  - g. Finish carpentry.
  - h. Architectural woodwork.
  - i. Wood paneling.
  - j. Wood veneer wall covering.
  - k. Wood flooring.
  - l. Wood lockers.
  - m. Wood cabinets.

## 2.6 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.

10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
3. Dry-Fog Coatings: VOC not more than 400 g/L.
4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
7. Pretreatment Wash Primers: VOC not more than 420 g/L.
8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.

12. Shellacs, Pigmented: VOC not more than 550 g/L.
  13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

### PART 3 - EXECUTION

#### 3.1 [REFRIGERANT] [AND] [CLEAN-AGENT FIRE-EXTINGUISHING-AGENT] REMOVAL

- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in HVAC Sections.
- B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Section 212200 "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

#### 3.2 MEASUREMENT AND VERIFICATION

- A. Credit EA 5.1[ and 5.2]: Implement measurement and verification plan consistent with [Option B: Energy Conservation Measure Isolation] [Option D: Calibrated Simulation, Savings Estimation Method 2] in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:
  1. <Insert measurement and verification plan design team submitted for credit>.
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

#### 3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2: Comply with Section 017419 "Construction Waste Management and Disposal."



### 3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQ 3: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
  - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  - 2. Replace all air filters immediately prior to occupancy.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

## END OF SECTION 018113.19

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Basis of Design (BOD) documentation included by reference for information only.
- C. Specification Sections:
  - 1. Section 013100 – Project Management and Coordination
  - 2. Section 013119 – Project Meetings
  - 3. Section 013300 – Submittal Procedures
  - 4. Section 014510 – Contractor Quality Control
  - 5. Section 213113 – Electric-Drive, Centrifugal Fire Pumps
  - 6. Section 213213 – Electric-Drive, Vertical-Turbine Fire Pumps
  - 7. Section 220513 – Common Motor Requirements for Plumbing Equipment
  - 8. Section 220519 – Meters and Gauges for Plumbing Piping
  - 9. Section 220529 – Hangers and Supports for Plumbing Piping and Equipment
  - 10. Section 220533 – Heat Tracing for Plumbing Piping
  - 11. Section 220548 – Vibration and Seismic Controls for Plumbing Piping and Equipment
  - 12. Section 220716 – Plumbing Equipment Insulation
  - 13. Section 220719 – Plumbing Piping Insulation
  - 14. Section 221116 – Domestic Water Piping
  - 15. Section 230400 – Basic HVAC Requirements
  - 16. Section 230513 – Common Motor Requirements for HVAC Equipment
  - 17. Section 230519 – Meters and Gages for HVAC Piping
  - 18. Section 230529 – Hangers and Supports for HVAC Piping and Equipment
  - 19. Section 230533 – Heat Tracing for HVAC Piping
  - 20. Section 230548.13 – Vibration Controls for HVAC
  - 21. Section 230593 – Testing, Adjusting, and Balancing for HVAC
  - 22. Section 230713 – Duct Insulation
  - 23. Section 230716 – HVAC Equipment Insulation
  - 24. Section 230719 – HVAC Piping Insulation
  - 25. Section 230800 – Commissioning Of HVAC
  - 26. Section 230900 – Instrumentation and Control for HVAC
  - 27. Section 230923 – Direct Digital Control (DDC) System for HVAC
  - 28. Section 230993 – Sequence of Operations for HVAC Controls
  - 29. Section 230993.11 – Sequence of Operations for HVAC DDC
  - 30. Section 260529 – Hangers and Supports for Electrical Systems
  - 31. Section 260533 – Raceways and Boxes for Electrical Systems
  - 32. Section 260536 – Cable Trays for Electrical Systems
  - 33. Section 260539 – Underfloor Raceways for Electrical Systems

34. Section 260548 – Vibration and Seismic Controls for Electrical Systems

1.2 SUMMARY

A. Scope

1. Commissioning requirements common to all Sections
2. Systems and equipment functional performance testing
3. Validation of proper and thorough installation of systems and equipment
4. Equipment performance verification
5. Documentation of tests, procedures, and observations.
6. Review of DEN Training agency.

B. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

C. Related Sections

D. Related Sections

1. Section 230800 "Commissioning of HVAC" and Section 260800 "Commissioning of Electrical" for commissioning process activities for HVAC&R systems, assemblies, equipment, components, and electrical systems.
2. Section 260800 - Commissioning of Electrical.

1.3 DEFINITIONS

- A. Acceptance Phase: The phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing and formal training occurs. This will generally occur after the Construction Phase is complete (start-up and checks have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Final I Completion.
- B. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the Contract and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- C. Commissioning Authority (CA or CxA): The Party retained by DEN who will oversee the Commissioning process as well as develop and stipulate many of the Commissioning requirements. They will also manage the Commissioning process, and ensure and validate that systems and equipment are designed, installed, and tested to meet DEN's requirements.
- D. Commissioning Contact (CxC): Individuals, appointed by the installing contractor, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action.

- E. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- F. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subcontractors complete the installation, complete start-up documentation, submit operation and maintenance information, establish trends, and perform any other applicable requirements to get systems started. Contractor and Vendors may also conduct equipment specific training. The Construction Phase will generally end upon Substantial Completion.
- G. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General Contractor, subcontractors, or vendors as inferred by its usage.
- H. Deficiency: A condition in the installation or function of a component, piece of equipment or system that does not comply with the Contract Documents, i.e., does not perform properly or is not complying with the design intent.
- I. Energy Management Control System (EMCS): The computer-based heating, ventilation, and air-conditioning (HVAC) control system.
- J. Factory Authorized Representative: An individual fully trained on the equipment and certified by the manufacturer to perform the respective task.
- K. Factory Testing: Testing of equipment off-site at the manufacturer's facility. The testing may be witnessed by the members of the project team.
- L. Functional Performance Testing (FPT): The detailed and thorough testing of building systems and their interactions with building components and other building systems.
- M. Issue Log: This list is maintained and updated by the Commissioning Authority that includes all Issue items that relate to Commissioning activities and site observations requiring contractor action or response.
- N. Maximum Failure Limit: The maximum percentage of a test population that is permitted to fail before the test is considered a failure and subject to correction and retesting. Where test sampling is used, the Maximum Failure Limit shall be the maximum percentage of a test sample that is permitted to fail before an entirely new sample must be selected for testing.
- O. Operation and Maintenance (O&M) Documentation: Contractor-developed documentation designed to address the needs of facilities personnel and customized for the context of the specific facility and installation. This includes manufacturer's literature (including O&M manuals, parts lists, troubleshooting guides, etc.), Contractor-developed instructions for start-up and shut-down, control sequences, and other installation-specific information.
- P. Pre-Start Up: Preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary

service.

- Q. Start-Up: Refers to the quality control process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing, including Start-Up Tests.
- R. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- S. Test, Adjust, and Balance (TAB): Refers to the test, adjust, and balance process or the Testing, Adjusting, and Balancing Contractor.
- T. Trending: Monitoring and recording a history of parameters typically using the EMCS.

#### 1.4 ACTION SUBMITTALS

##### A. General requirements:

1. Provide individual checklists and procedures for each system or component.
2. Develop individual checklists and procedures for each tagged piece of equipment. General procedures developed for multiple pieces of equipment, including similar equipment, are not acceptable.
3. Procedures and checklists for specified phases of commissioning (e.g. Pre-startup, startup, functional performance testing) must be submitted and approved prior to commencement of the related activity.

##### B. CxA submittals:

1. Commissioning plan.
2. Pre-functional checklists: For each system or component.
3. Startup procedures: For each system or component.
4. Startup checklists: For each system or component.
5. Completed startup checklists: For each system or component.
6. Functional Test Procedures: For each system or component.
7. Functional Test Checklists: For each system or component.
8. Formal acceptance recommendation for each component or system tested, following successful completion of testing.

##### C. Contractor submittals:

1. Completed pre-functional checklists: For each system or component.
2. Completed startup checklists: For each system or component.
3. Completed functional test checklists: For each system or component.

#### 1.5 INFORMATIONAL SUBMITTALS

A. CxA submittals:

1. Qualifications: For CxA and testing technicians.
2. Test equipment calibration certificates.
3. Preliminary Commissioning Report, including the following:
  - a. Compiled test results.
  - b. Updated Issues Log.
  - c. Updated Checklist log.
4. Final Commissioning Report, including the following:
  - a. Compiled test results.
  - b. Seasonal test results.
  - c. Warranty walkthrough results.
  - d. Completed issues log.
  - e. Completed checklist log.

1.6 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Contractor shall appoint a CxC.
2. The commissioning team shall consist of, but not be limited to, representatives of **[each]** Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by DEN Project Manager:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. DEN will engage the CxA under a separate contract.
2. Representatives of DEN Sustainability, DEN Project Manager Representative, and DEN Maintenance personnel.
3. Architect and engineering design professionals.

1.7 DEN'S RESPONSIBILITIES

- A. Assign DEN Sustainability and Operations Maintenance personnel and schedule them to participate in commissioning team activities.
- B. Coordinate activities specified in paragraph below with DOR and Architect-Consultant agreements.
- C. Provide the BoD documentation, prepared by DOR, and approved by DEN, to the CxA and **[each]** Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.8 [EACH] CONTRACTOR'S RESPONSIBILITIES

A. [Each] Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Include Commissioning requirements in price and plan for work.
2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
3. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
4. Attend commissioning team meetings held on a [weekly] [biweekly] [monthly] [variable] <Insert frequency> basis and progressing to weekly meetings as construction project nears completion.
5. Integrate and coordinate commissioning process activities with construction schedule.
6. Review and accept construction pre-functional checklists provided by the CxA prior to commencing functional testing.
7. Complete electronic construction checklists as Work is completed and provide to the DEN Project Manager after each checklist has been completed.
8. Review and accept commissioning process functional test procedures provided by the Commissioning Authority.
9. Designate a CxC from each major subcontractor with activities related to commissioning. These CxCs are to be the primary contacts for Commissioning activities.
10. Contractor shall incorporate the Commissioning process into the construction schedule, outlining generic Commissioning tasks with precedents or prerequisites to each task. These tasks will apply to many systems and the Contractor shall incorporate as such. Examples of enumerated tasks include, but are not limited to:
  - a. Contractor preparation of the Training Plan
  - b. Testing Agency activities
  - c. Contractor documentation of pipe pressure testing, flushing, and cleaning of applicable systems
  - d. Documentation of the Start-Up Procedures for equipment and systems
  - e. TAB of applicable system
  - f. Preparation of the O&M Manual content
  - g. FPT and Acceptance
  - h. Observation Period and System Optimization
  - i. Occupant or other Regulatory Agency testing or approval process
11. Assist the CxA in preparation for the specific FPT procedures. Contractors, subcontractors, and vendors shall review the FPTs to ensure feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures that is the result of malfunctioning equipment or contract deficiencies, shall be the responsibility of the Contractor.
12. Record start-up and testing procedures.
13. Demonstrate the operation of all systems as specified.

- a. Operate systems, with assistance of DEN Maintenance, under direction of the CxA during FPT's and other acceptance testing.
- B. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Acceptance Phase.
1. Work in conjunction with CxA in FPT and shall include, but not limited to the following:
    - a. Operate and Manipulate systems and equipment to facilitate testing (as dictated in this section, relevant technical sections and the Commissioning Plan).
    - b. Operate and Manipulate EMCS and other control systems to facilitate FPT (as dictated in this section, relevant technical sections and the Commissioning Plan).
  2. Correct any work not in accordance with Contract Documents.
  3. Maintain record documentation and update and resubmit it after Functional Completion.
  4. Compensate DEN for additional CxA fees and expenses incurred to retest equipment and systems following testing failures.
  5. Monitor systems, equipment, and areas throughout the Transition Period. Log and diagnose all alarms during this period. Maintain trends and logs of all critical parameters. Forward the logs and trends on a weekly basis throughout all Transition Periods.
- C. Warranty Period: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Warranty Period.
1. Provide warranty service
  2. Conduct EMCS Sequence Training
  3. Respond to and document Warranty issues
  4. Correct any deficiencies identified throughout the Warranty Period
  5. Update record documentation to reflect any changes made throughout the Warranty Period and resubmit final Record Drawings and data records at the close of the Warranty period
- 1.9 CxA'S RESPONSIBILITIES
- A. Organize and lead the commissioning team through the entire project.
  - B. Provide and update [**design phase**] [**and**] [**construction phase**] commissioning plans.
  - C. Convene commissioning team meetings to discuss commissioning activities and current issues and resolutions.
  - D. Provide Project-specific construction checklists and commissioning process test procedures.
  - E. Review all pertinent equipment submittals, shop drawings, and O&M documentation.



- F. Verify the execution of commissioning process activities. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the DPR. When a requirement is not met, the CxA will report the failure in the Issues Log.
- G. Prepare and maintain the Issues Log.
- H. Prepare and maintain completed construction checklist log.
- I. Organize and lead the functional, seasonal, any LEED required tests, and 10-month Warranty review in the presence of the contractor, DEN Maintenance, and DEN PM assigned personnel.
- J. Witness systems, assemblies, equipment, and component startup.
- K. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

#### 1.10 ISSUES LOG

- A. CxA shall maintain an Issues Log (required information, identified deficiencies, work required, etc.) that relates to Commissioning. Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and for documentation on applicable forms.
- B. CxA will provide this list to the DEN Project Manager during regular project meetings as appropriate to keep all parties informed.
- C. All parties indicated as responsible for an action item shall respond to the DEN Project Manager. Responses are due within 10 days of action items being identified to the team.

#### 1.11 PRE-START UP

##### A. PREREQUISITES

- 1. All equipment, components, and devices applicable to the Pre-Start Up must be installed, and the Pre-Start Up must be documented and approved. This includes installation, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.

##### B. COMMON ELEMENTS

- 1. Required submittal documentation shall be present and located convenient to testing area.
- 2. Contractor shall submit the completed Pre-Start Up Procedures at least 10 days prior to the start of Functional testing. CxA shall review the Pre-Start Up Procedure documentation at the beginning of Start Up. Contractor shall

- demonstrate to DEN Project Manager, DEN Maintenance and DEN Sustainability that access is sufficient to perform required maintenance.
3. System and equipment configurations shall be compared against the contract documents.

#### 1.12 INSTRUMENTATION

- A. All test instruments described in this section shall be acceptable for any portion of the commissioning process herein described.
- B. All instruments shall conform to the standards specified in the most recent edition of "NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" regarding accuracy and calibration status. Current calibration certificates must be available to the CxA if requested.
- C. Test instrument accuracy and resolution must match or exceed that of the system component being verified or calibrated.
- D. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring methods must be appropriate to the instrument application and measurements must be repeatable under equivalent conditions.
- E. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and diagnosis shall be provided by testing entity. These include, but are not limited to:
  1. Electronic Manometer (for Air and Flow Hood)
  2. Electronic Manometer (for Water)
  3. Temperature Instruments
  4. **[Pressure instruments]**
  5. Humidity Instruments
  6. CO2 Instrument
  7. Sound Meter
  8. Electronic Multimeter
  9. Tachometer
  10. Ultrasonic Flow Meter
  11. Others as required

#### 1.13 START-UP

- A. Prerequisites
  1. All equipment, components, and devices applicable to the FPT must be started, and the Start-Up must be documented and approved. This includes completion of Start-Up Procedures, pressure testing (of equipment, duct and piping), flushing/cleaning, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.
  2. Unless specifically agreed to by DEN and CxA, all support systems shall be

- complete prior to FPT.
3. The CxA shall determine the optimal sequence of testing.

B. Common Elements

1. Required submittal documentation shall be present and located convenient to testing area. Validate that all required documentation has been submitted and **[complete]** per the contract requirements.
2. Contractor shall provide the completed Start-Up Procedures at the time of testing. CxA shall review the Start-Up Procedure documentation and spot-check at the beginning of FPT.

C. Procedure

1. Purpose:
  - a. Verify adherence to, and documentation of, quality control processes involved with preparing systems and equipment for operation.
  - b. These procedures shall be performed on all installed systems and equipment and no sampling strategy is used for the start-up process.
  - c. The Commissioning process requires all Parties to collaborate to establish the optimal standard of care for starting systems and equipment.
  - d. After the procedures are established, the Contractor performs them and documents them with the Start-up Procedures that are developed by the Contractor.
2. Start-Up Procedures: The content of these Start-Up Procedures shall provide the minimally acceptable content in accordance with the OEM field quality control requirements. Generic refers to the fact that the protocols may be created before the shop drawings are finalized. These procedures and protocols will normally be common across different manufacturers.
3. Content of Start-Up Procedures: Start-Up Procedures shall generally include the following for each item of equipment or system (as applicable):
  - a. Project-specific designation, location, and service.
  - b. Indication of the Party performing and documenting the Start-Up Procedure.
  - c. Clear explanation of the inspection, test, measurement, and outcome with a Pass/Fail indication and a record of measure parameters.
  - d. A Start-up Checklist item indicating that proper maintenance clearances have been maintained.
4. Recording and Documentation of Factory Start-Up: Manufacturer's start-up protocols shall be executed and forms shall be completed by a qualified/authorized technician.
5. Recording and Documentation of non-Factory Start-Up: The start-up tests and checklists shall be completed by a qualified technician.
6. Commissioning Authority Review: CxA will review and spot-check procedures during FPT.
7. Documentation Completion: The individual executing the start-up must complete the start-up and pre-functional documentation for any given equipment and

- acknowledge acceptability with the indication of who did the associated task.
8. Sampling and Final Submission: All (100% of) systems are started and documented per the approved procedures and NO sampling strategy is used. Completed Start-up and pre-functional checklists for all pieces of equipment associated with independent systems shall be submitted to CxA prior to any associated FPT. Any outstanding item shall be clearly indicated and an associated Action Item must be entered to track resolution.
  9. DEN Access: Contractor shall allow access by DEN representatives to inspect the equipment and ensure its proper operation.

#### 1.14 TEST, ADJUST, AND BALANCE

- A. CxA shall review TAB reports.
- B. The CxA shall select up to 10% of the readings from the Balancing Reports and verify performance readings. Readings selected by the CxA may include:
  1. Supply air diffuser readings (both minimum and maximum readings for variable air volume boxes).
  2. Main and branch supply duct traverse readings.
  3. Outside/return air flow readings.
  4. Exhaust airflow readings.
  5. Water flow readings.
  6. Ampere readings.
  7. Water pressure drop readings through coils, heat exchangers, and other hydronic elements.
- C. For all readings, a deviation of more than 10% between the verification reading and reported data shall be considered as failing the FPT. The maximum failure rate for the sample is 10%.
- D. If greater than 10% of sample readings have failed, the TAB contractor shall justify all noted failures or rebalance and re-document the system.

#### 1.15 FUNCTIONAL PERFORMANCE TESTING

- A. Objectives and Scope
  1. Demonstrate that each system is operating according to the documented design intent and Contract Documents.
  2. Bring all commissioned systems from a state of substantial completion to full dynamic operation.
  3. Identify and correct performance deficiencies.
  4. Operate each system through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, normal and emergency power, fire alarm, part-and full-load) where there is a specified system response.
  5. Verify each sequence in the sequences of operation as required.
  6. Verify responses to abnormal operational modes and conditions, such as power

failure, freeze conditions, no flow, equipment failure, etc.

B. Development of Test Procedures

1. CxA shall develop specific **[and custom]** test procedures to verify and document proper operation of each piece of equipment and system.
2. CxA shall develop fill-in forms for use during FPT, based on the test procedures.
3. Not less than 14 days prior to execution of FPT, CxA shall submit completed test procedures to the DEN Project Manager to review the tests for feasibility, safety, equipment and warranty protection, and scope.
4. EMCS trends shall have been established as required in the documents. These shall generally be reviewed prior to or during FPT.
5. Capacities and adjusted/balanced conditions as applicable shall be subject to review.
6. Sequencing Verification: For applicable systems and equipment, all modes of operation shall be verified for proper sequencing.
7. System and equipment configurations shall be compared against the contract documents.
8. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe, and stable operation.

C. Scheduling:

1. Contractor shall notify the CxA and the DEN Project Manager that systems are ready for testing, to schedule FPT.
2. To the extent practical, tests shall be scheduled to allow efficient and contiguous testing of inter-related systems and equipment.

D. Phasing:

1. Non-interdependent segments of the project testing may be phased.
2. Phasing of FPT for this project shall be coordinated between the CxA, Contractor, and the DEN Project Manager as the project progresses.

E. Participation:

1. CxA shall witness and document FPTs performed by the contractor after Start-Up Procedure documentation of systems and equipment has been reviewed and accepted.
2. Contractor shall perform the FPTs as described, with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, safety equipment), and on-the-spot remediation of minor identified deficiencies whenever possible.
3. Required participating Parties shall be indicated in the test plan for each individual FPT.
4. Required participating parties shall be available on-site throughout the testing of any given system for which they are required participants.
5. CxA shall coordinate effectively with the individual Contractors throughout FPT and minimize their required involvement.

F. Completeness:

1. All systems must be completed and ready for FPT at the time of the test.
2. All start up, factory authorized field testing, independent testing agency tests, and TAB procedures must be complete and the control systems must be tested and operational for the respective system or component.

G. Test Documentation:

1. CxA shall witness and document the tests.
2. CxA shall record all test results on the forms developed for the testing.
3. CxA shall 'Pass' or 'Fail' the testing and record the date and time of the test.
4. Deficiencies shall be clearly indicated when the test is failed.
5. When all related testing is completed successfully, CxA shall recommend acceptance of the system or component.
6. In the case of specialized testing, CxA shall witness and review the testing reports prepared by the Contractor.

H. Acceptance Criteria

1. The Acceptance Criteria shall be as follows unless specifically indicated within applicable individual specification sections or test procedures.
  - a. Accuracy/repeatability on sensing devices will be as specified for the device. CxA and TAB will use calibrated gauges for independent validation of sensing devices.
  - b. HVAC sequence-related criteria will be as specified in the documents.

I. Deficiencies

1. CxA shall record the results of each functional test. All deficiencies or non-conformance issues shall be brought to Contractor's attention immediately, noted in the Issues Log, and reported to the DEN Project Manager within 72 hours.
  - a. Corrections of identified minor deficiencies may be made during the tests where feasible. In such cases, the deficiency will be noted on the FPT documents.
  - b. Deficiencies with potential schedule or cost impacts shall be reported to the DEN Project Manager within 24 hours of discovery.
2. Contractor shall correct all identified deficiencies as directed by the DEN Project Manager.
  - a. CxA shall maintain Contractor's response to each deficiency in the Issues Log.
  - b. Contractor shall correct each deficiency, and notify CxA upon completion by completing an action item response.
  - c. Contractor shall schedule repeat testing and ensure CxA is available to observe.

3. Disputes:

- a. Contractor shall notify the DEN Project Manager and CxA immediately if the responsibility or nature of any identified deficiency is in dispute.
- b. The CxA shall document as a disputed deficiency in the Issues Log.
- c. The Contractor shall negotiate a resolution to the dispute with the DEN Project Manager.
- d. Upon resolution, CxA shall update the Issues Log to reflect the status of the deficiency

J. Sampling Percentage:

1. Sampling percentage shall be as indicated in the test plan.
2. Where no sampling percentage is indicated, the implied sampling percentage is 100% and all units shall be tested.

K. Maximum Failure Limit:

1. Maximum Failure Limit shall be as indicated in the test plan.
2. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
3. If no Maximum Failure Limit is indicated, the implied failure limit is 0% and all tested samples must pass.
4. Where sample tests involve multiple systems (i.e., checking strainers on different hydronic systems), the Maximum Failure Limit will apply per system.
5. The responsible Contractors shall reimburse DEN for the CxA's cost of that sample test, and redo the start-up and TAB for the applicable devices/systems.
6. All work necessitated by sample failures shall be at no cost to DEN.

L. Manufacturer's Defects:

1. If 10% of identical pieces of equipment fail to perform to the Contract Documents (mechanically or substantively) due to a manufacturing defect, all identical units may be considered unacceptable by the DEN Project Manager.
2. For the purposes of defining 'identical equipment' for this Section, size or capacity alone does not constitute a difference.
3. In case of failure due to manufacturer's defects, the Contractor shall provide DEN with the following:
  - a. Manufacturer's response in writing as to the cause of the failure and proposed resolution.
  - b. Manufacturer shall implement their proposed resolution on a representative sample of the product.
  - c. The DEN Project Manager will determine whether a replacement of all identical units or a repair is acceptable.
  - d. Upon acceptance, the Contractor shall replace or repair all identical items at their expense and shall extend the warranty accordingly (if the original equipment warranty had begun).
  - e. Manufacturer shall pay the costs of all retesting necessitated by the failure.

## 1.16 CLOSEOUT

### A. Commissioning Report

1. A final summary report by the CxA shall be provided to the DEN Project Manager, focusing on evaluating commissioning process issues and identifying areas where the process could be improved.
2. Include all acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., compiled in appendices, and provided with the summary report.
3. Pre-Start Up verification, Start Up checklists, TAB, functional tests, and monitoring reports shall not be included the final report, but shall be submitted as part of the Commissioning Record in the O&M manuals.

### B. Logs

1. CxA shall submit an updated Issues Log and all Issues Logs upon substantial completion of the project.

### C. Acceptance

1. CxA shall recommend acceptance of each test in writing to the DEN Project Manager.
2. The CxA shall note each satisfactorily demonstrated function on the test documentation.
3. Tests shall be considered accepted only upon formal acceptance by the DEN Project Manager.

### D. Training

1. The Contractor shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
2. The CxA shall witness the content and adequacy of the training of DEN personnel for commissioned equipment. Any issues shall be noted in the Issues Log and reported immediately to the DEN Project Manager.

### E. Operation and Maintenance Manual and Record Drawing Review

1. Prior to substantial completion, the CxA shall review the O&M manuals, documentation, and redlined as-built drawings for systems that were commissioned to verify compliance with the Specifications.
2. The CxA shall review completed record drawings and document any discrepancies in the Issues Log.

## 1.17 WARRANTY PERIOD

### A. Warranty Walkthrough

1. General Requirements



- a. Contractor and CxA, as directed by the DEN Project Manager, shall participate in an on-site walkthrough to review the condition of the project prior to expiration of the Contractor's warranty (the "warranty walkthrough").
  - b. The warranty walkthrough shall occur not less than nine (9) months following substantial completion, and not more than eleven (11) months following substantial completion.
  - c. Any deficiencies identified during the warranty walkthrough shall be identified and tracked using the Issues Log, and shall be provided in writing to the DEN Project Manager.
2. Required Attendees:
- a. Installing Contractor, and subcontractor representatives.
  - b. TAB Contractor.
  - c. CxA.
  - d. DEN Project Manager, or authorized representative.
  - e. DEN Asset Manager, or authorized representative.
  - f. **<insert attendees>**.
3. Contractor's Responsibilities
- a. Contractor shall provide personnel at the warranty walkthrough as necessary to facilitate operation of equipment and testing procedures. Confirm with the DEN Project Manager a full list of attendees with their contact information not less than (4) weeks prior to scheduled warranty walkthrough. Required attendees shall include:
    - 1) Contractor's Project Manager.
    - 2) Manufacturer's representative(s) for commissioned equipment.
    - 3) Electrical Subcontractor.
    - 4) Mechanical Subcontractor.
    - 5) Others, as required by the DEN project Manager.
    - 6) **<insert attendees>**.
  - b. Contractor, or designated subcontractor or manufacturer's representative under direction of Contractor, shall operate equipment during the warranty walkthrough as directed by the DEN Project Manager.
4. CxA's Responsibilities
- a. CxA, under direction from the DEN Project Manager and DEN Asset Management, shall facilitate the inspection and verification of all commissioned systems as part of the on-site warranty walkthrough.
  - b. CxA shall perform visual inspection of equipment to document any warranty-related defects or damage.
  - c. CxA shall perform basic functional verification of equipment to affirm the equipment is operating in compliance with Contract Documents.
  - d. The CxA shall document any deficiencies found during the warranty walkthrough in the Issues Log and notify the DEN Project Manager.
  - e. Required documentation:

- 1) Not less than (4) weeks prior to the scheduled warranty walkthrough, submit a warranty inspection checklist, including:
  - a) A section for each individual piece of equipment.
  - b) Expected attendees and responsibilities.
  - c) Fields or checkboxes for each individual inspection procedure or measurement as directed by the DEN Project Manager.
- 2) CxA shall provide the approved warranty inspection checklist for use on-site at the warranty walkthrough.
- 3) CxA shall provide the current Issues Log for use on-site at the warranty walkthrough.
- 4) CxA shall provide an updated Issues Log to the DEN Project Manager following completion of the warranty walkthrough.

**B. Seasonal Testing**

1. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract.
2. The CxA shall coordinate this activity with the DEN Project Manager and the Contractor.
3. Tests will be executed, documented and deficiencies corrected by the appropriate parties, with DEN maintenance staff and the CxA witnessing.
4. Any final adjustments to the O&M manuals and Record Drawings due to the testing will be made by the responsible parties.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**PART 4 - MEASUREMENT**

**4.1 METHOD OF MEASUREMENT**

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

**PART 5 - PAYMENT**

**5.1 METHOD OF PAYMENT**

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

END OF SECTION 019113

**SECTION 019990 - STANDARD FORMS**

Per the DEN Technical Specification Committee, this section is deleted from the DEN Technical Specification Library.

Please refer to the individual Sections for form information.

**END OF SECTION 019990**

## SECTION 024116 - STRUCTURE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

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

B. Related Sections:

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

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

#### 1.3 DEFINITIONS

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

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

#### 1.4 MATERIALS OWNERSHIP

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

#### 1.5 INFORMATIONAL SUBMITTALS

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

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

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

## 1.6 QUALITY ASSURANCE

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

## 1.7 PROJECT CONDITIONS

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

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

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

## **PART 2 - PRODUCTS [ Not Used]**

### 2.1 SOIL MATERIALS

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

## **PART 3 - EXECUTION**

### 3.1 DEMOLITION CONTRACTOR

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

### 3.2 EXAMINATION

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



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

### 3.3 PREPARATION

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

### 3.4 PROTECTION

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

### 3.5 DEMOLITION, GENERAL

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

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

### 3.6 DEMOLITION BY MECHANICAL MEANS

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

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

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

### 3.7 DEMOLITION BY EXPLOSIVES

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

### 3.8 SITE RESTORATION

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

### 3.9 REPAIRS

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

### 3.10 RECYCLING DEMOLISHED MATERIALS

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

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

### 3.11 DISPOSAL OF DEMOLISHED MATERIALS

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

3.12 CLEANING

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

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **024116**



## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

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

- B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 024116 "Structure Demolition" for demolition of buildings and structures.
3. Section 230505 "Selective Demolition for Mechanical" for demolition of fire suppression, plumbing, and HVAC systems.
4. Section 260505 "Selective Demolition for Electrical" for demolition of electrical systems.
5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

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

#### 1.3 DEFINITIONS

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

or removed and reinstalled.

#### 1.4 MATERIALS OWNERSHIP

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

#### 1.5 PREINSTALLATION MEETINGS

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

#### 1.6 INFORMATIONAL SUBMITTALS

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

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

#### 1.7 CLOSEOUT SUBMITTALS

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

#### 1.8 QUALITY ASSURANCE

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

#### 1.9 FIELD CONDITIONS

- A. When there are occupied portions of buildings immediately adjacent to selective demolition area, conduct selective demolition so DEN's or tenant's operations will not be disrupted.
1. Provide not less than 72 hours' notice to DEN Project Manager of activities that will affect DEN's or tenant's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. DEN assumes no responsibility for condition of areas to be selectively demolished. DEN will maintain conditions existing at time of inspection for bidding purpose as far as practical.
- D. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:
    - a. **<Insert items to be removed by Owner>**.
- E. Notify DEN Project Manager of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- F. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify DEN Project Manager. Hazardous materials will be removed by Owner under a separate contract.
- G. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- H. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by [**12 inches** (300 mm)] **<Insert dimension>** or more.

- I. Storage or sale of removed items or materials on-site is not permitted.
- J. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection facilities in service during selective demolition operations.

#### 1.10 WARRANTY

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

#### 1.11 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
- B. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that, when installed, will match the visual and functional performance of

existing materials, as approved by DEN Project Manager.

- C. Use materials whose installed performance equal or surpass that of existing materials.
- D. Comply with material and installation requirements specified in individual specification sections.

## 2.2 PERFORMANCE REQUIREMENTS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to DEN Project Manager.

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

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. No system component shall be abandoned in place.
- B. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
  2. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by the DEN Project Manager and authorities having jurisdiction.
- C. Existing Services/Systems to Be Removed, or Relocated: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off indicated utilities and obtain prior written approval with DEN Project Manager and utility companies.
  2. If services/systems are required to be removed, or relocated, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

- a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
  - e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- D. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 1. Comply with requirements for access and protection specified in Section 015210 "Temporary Facilities."
  - 2. Do not close or obstruct roads, streets, walks, walkways, or other adjacent occupied or used facilities without written authorization from the DEN Project Manager and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
  - 3. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
  - 4. Protect existing site improvements, appurtenances, and landscaping.
  - 5. Erect a plainly visible fence around drip lines of individual trees or around perimeter drip lines of groups of trees.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as



required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing buildings and construction projects, both in progress and completed, from exposure, foul weather and other construction operations. Provide temporary weather tight enclosures for building exteriors.
1. Where heating or cooling is needed and permanent enclosures are not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
  2. Contractor shall be responsible for any damage to existing conditions due to inadequate temporary enclosures or due to failure of temporary enclosures.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain[ **fire watch and**] portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly. [ **Comply with requirements in Section 017419 "Construction Waste Management and Disposal."** ]
  
  - B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without DEN Project Manager's approval.
    1. Building Structure and Shell: [75] [100] percent.
    2. Nonshell Elements: 50 percent.
    3. Nonshell Elements: [40] [60] percent.
  
  - C. Removed and Salvaged Items:
    1. Clean salvaged items.
    2. Pack or crate items after cleaning. Identify contents of containers.
    3. Store items in a secure area until delivery to DEN.
    4. Transport items to DEN's storage area as designated by the DEN Project Manager.
    5. Protect items from damage during transport and storage.
  
  - D. Removed and Reinstalled Items:
    1. Clean and repair items to functional condition adequate for intended reuse.
    2. Paint equipment to match new equipment, with coatings of equal color, finish and performance of new equipment.
    3. Pack or crate items after cleaning and repairing. Identify contents of containers.
    4. Protect items from damage during transport and storage.
    5. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
  
  - E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by DEN Project Manager, items may be removed to a suitable, protected storage location during selective demolition [ **and cleaned** ] and reinstalled in their original locations after selective demolition operations are complete.
- 3.5 PATCHING AND REPAIRS
- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
  
  - B. Patching: Comply with Specification Section 017330 "Cutting and Patching".
  
  - C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
    1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's

written recommendations.

- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements as specified in other sections of these specifications.
  - 2. Where patching occurs on a painted surface, apply primer and intermediate paint coats over the patch and apply a final paint coat over the entire unbroken surface containing the patch. Provide additional coats until the patch blends with adjacent surfaces.
  - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." [ **Do not use methods requiring solvent-based adhesive strippers.** ]
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See

Section <Insert Section number> "<Insert Section title>" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

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

### 3.8 CLEANING

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

### 3.9 SELECTIVE DEMOLITION SCHEDULE

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

## PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

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

END OF SECTION **024119**

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

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

#### 1.3 DEFINITIONS

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

#### 1.4 ACTION SUBMITTALS

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

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

#### 1.5 INFORMATIONAL SUBMITTALS

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



1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

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

## 1.8 DELIVERY, STORAGE, AND HANDLING

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

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

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

## 1.9 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

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

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

## 2.2 STEEL REINFORCEMENT

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

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

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

## 2.3 REINFORCEMENT ACCESSORIES

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

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

## 2.4 CONCRETE MATERIALS

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

## 2.5 ADMIXTURES

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

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

- f. QC Construction Products.
  - g. Rockwood Pigments NA, Inc.
  - h. Scofield, L. M. Company.
  - i. Solomon Colors, Inc.
  - j. **<Insert manufacturer's name>**
  - k. or approved equal.
2. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

## 2.6 FIBER REINFORCEMENT

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

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

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

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

- b. Fiber: Type 2, Cut Sheet:

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

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

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

- a. Monofilament Micro-Fibers:

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



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

b. Fibrillated Micro-Fibers:

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

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

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

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

## 2.7 WATERSTOPS

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

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

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

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

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

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

## 2.8 VAPOR RETARDERS

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

pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Fortifiber Building Systems Group; Moistop Ultra 6.
  - b. Raven Industries Inc.; Griffolyn [**Type-65**] [**10 mil Green**].
  - c. Stego Industries, LLC; Stego Wrap, 10 mil Class A.
  - d. <Insert manufacturer's name>
  - e. or approved equal.
  
- C. Sheet Vapor Retarder: ASTM E 1745, Class C[, **except with maximum perm rating of <Insert rating>**]. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fortifiber Building Systems Group; Moistop Plus.
    - b. Raven Industries Inc.; Vapor Block 6.
    - c. Reef Industries, Inc.; Griffolyn [**Type-65**] [**Type-85**].
    - d. Stego Industries, LLC; Stego Wrap, 10 mil Class C.
    - e. <Insert manufacturer's name>
    - f. or approved equal.
  
- D. Bituminous Vapor Retarder: **110-mil-** (2.8-mm-) thick, semiflexible, 7-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories including bonding asphalt, pointing mastics, and self-adhering joint tape.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Meadows, W. R., Inc.; Premoulded Membrane Vapor Seal.
    - b. <Insert manufacturer's name>
    - c. or approved equal.
  2. Water-Vapor Permeance: **0.00 grains/h x sq. ft. x inches Hg** (0.00 ng/Pa x s x sq. m); ASTM E 154.
  3. Tensile Strength: **140 lbf/inch** (24.5 kN/m); ASTM E 154.
  4. Puncture Resistance: **90 lbf** (400N); ASTM E 154.
  
- E. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a **1-1/2-inch** (37.5-mm) sieve and 0 to 5 percent passing a **No. 8** (2.36-mm) sieve.
  
- F. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a **3/8-inch** (9.5-mm) sieve, 10 to 30 percent passing a **No. 100** (0.15-mm) sieve, and at least 5 percent passing **No. 200** (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

## 2.9 FLOOR AND SLAB TREATMENTS

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

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

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

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

## 2.10 LIQUID FLOOR TREATMENTS

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

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

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

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

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

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

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

## 2.11 CURING MATERIALS

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

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

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

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



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

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

24).

## 2.12 RELATED MATERIALS

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

## 2.13 REPAIR MATERIALS

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

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

## 2.14 CONCRETE MIXTURES, GENERAL

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

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

## 2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.16 FABRICATING REINFORCEMENT

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

2.17 CONCRETE MIXING

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

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

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

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



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

### PART 3 - EXECUTION

#### 3.1 FORMWORK

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

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

### 3.2 EMBEDDED ITEMS

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

### 3.3 REMOVING AND REUSING FORMS

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

### 3.4 SHORES AND RESHORES

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

shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints **6 inches** (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with [**granular fill**] [**fine-graded granular material**], moisten, and compact with mechanical equipment to elevation tolerances of plus **0 inch** (0 mm) or minus **3/4 inch** (19 mm).
1. Place and compact a **1/2-inch-** (13-mm-) thick layer of fine-graded granular material over granular fill.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

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

### 3.7 JOINTS

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

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

### 3.8 WATERSTOPS

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

### 3.9 CONCRETE PLACEMENT

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

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

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

### 3.10 FINISHING FORMED SURFACES

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

### 3.11 FINISHING FLOORS AND SLABS

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

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



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

### 3.12 MISCELLANEOUS CONCRETE ITEMS

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

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

### 3.13 CONCRETE PROTECTING AND CURING

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

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

### 3.14 LIQUID FLOOR TREATMENTS

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

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

### 3.15 JOINT FILLING

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

### 3.16 CONCRETE SURFACE REPAIRS

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

sloped template.

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

- E. Perform structural repairs of concrete, subject to DEN Project Manager's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to DEN Project Manager's approval.

### 3.17 FIELD QUALITY CONTROL

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

C. Inspections:

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

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

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

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

### 3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

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

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 033000



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

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

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

#### **1.3 ACTION SUBMITTALS**

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

1. Design Mixtures: For each concrete mixture.

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

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

#### 1.6 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 FORMWORK

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

### 2.2 STEEL REINFORCEMENT

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

### 2.3 CONCRETE MATERIALS

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

## 2.4 ADMIXTURES

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

## 2.5 RELATED MATERIALS

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

## 2.6 CURING MATERIALS

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

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

## 2.7 CONCRETE MIXTURES

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

## 2.8 CONCRETE MIXING

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

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

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

### **PART 3 - EXECUTION**

#### **3.1 FORMWORK**

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

#### **3.2 EMBEDDED ITEMS**

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

#### **3.3 VAPOR RETARDERS**

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

### 3.4 STEEL REINFORCEMENT

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

### 3.5 JOINTS

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

### 3.6 CONCRETE PLACEMENT

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

### 3.7 FINISHING FORMED SURFACES

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

### 3.8 FINISHING UNFORMED SURFACES

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



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

### 3.9 TOLERANCES

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

### 3.10 CONCRETE PROTECTING AND CURING

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

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

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

### 3.11 FIELD QUALITY CONTROL

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

### 3.12 REPAIRS

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

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

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

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DENVER INTERNATIONAL AIRPORT  
DEN TECH SPECS 2016  
CONTRACT NO.00000

END OF SECTION 033053

## SECTION 033300 - ARCHITECTURAL CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

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

#### 1.3 DEFINITIONS

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

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

#### 1.4 PREINSTALLATION MEETINGS

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

#### 1.5 ACTION SUBMITTALS

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

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

#### 1.6 INFORMATIONAL SUBMITTALS

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

#### 1.7 CLOSEOUT SUBMITTALS

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

## 1.8 QUALITY ASSURANCE

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

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



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

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

#### 1.9 PROJECT CONDITIONS

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

#### 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

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

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

## 2.2 STEEL REINFORCEMENT AND ACCESSORIES

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

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

## 2.3 CONCRETE MATERIALS

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

## 2.4 ADMIXTURES

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

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

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

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

## 2.5 CURING MATERIALS

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

## 2.6 REPAIR MATERIALS

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

## 2.7 CONCRETE MIXTURES, GENERAL

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

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

## 2.8 CONCRETE MIXING

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

## PART 3 - EXECUTION

### 3.1 FORMWORK

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

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

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

### 3.2 REINFORCEMENT AND INSERTS

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

### 3.3 REMOVING AND REUSING FORMS

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

### 3.4 JOINTS

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



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

### 3.5 CONCRETE PLACEMENT

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

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

### 3.6 PREPARATION

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

### 3.7 FINISHES, GENERAL

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

indicated.

### 3.8 AS-CAST FORMED FINISHES

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

### 3.9 EXPOSED-AGGREGATE FINISHES

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

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

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

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

E. Brushed Concrete Finish:

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

### 3.10 CONCRETE PROTECTING AND CURING

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

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

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

### 3.11 FIELD QUALITY CONTROL

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

### 3.12 REPAIRS, PROTECTION, AND CLEANING

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

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 033300

## SECTION 033320 - CONCRETE TOPPING (STANDARD AGGREGATES)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

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

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

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



1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

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

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

## 1.9 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 CEMENT AND AGGREGATES

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

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

## 2.2 TOPPING MIX

- A. Standard Topping:

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

- B. MIXING:

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

## 2.3 CURING MATERIALS

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

## 2.4 RELATED MATERIALS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

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

### 3.2 CONDITION OF SURFACES

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

### 3.3 JOINT PREPARATION

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

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

### 3.4 TOPPING APPLICATION

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

### 3.5 PLACING AND COMPACTING

- A. Float Finish:

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

### 3.6 TROWEL FINISH

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

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

### 3.7 JOINT FILLING

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

### 3.8 REPAIRS

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

### 3.9 FIELD QUALITY CONTROL

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

that it does not comply with specified requirements.

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

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 035300



## SECTION 034100 - PRECAST STRUCTURAL CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

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

- B. Related Sections:

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

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

#### 1.3 DEFINITION

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

## 1.4 PERFORMANCE REQUIREMENTS

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

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

## 1.5 ACTION SUBMITTALS

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

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

E. Samples:

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

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

1.6 INFORMATIONAL SUBMITTALS

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

## 1.7 CLOSEOUT SUBMITTALS

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

## 1.8 QUALITY ASSURANCE

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

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

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

#### 1.10 COORDINATION

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

#### 1.11 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 MOLD MATERIALS

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

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

## 2.3 REINFORCING MATERIALS

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

## 2.4 PRESTRESSING TENDONS

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



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

## 2.5 CONCRETE MATERIALS

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

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

## 2.6 STEEL CONNECTION MATERIALS

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

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

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

## 2.7 STAINLESS-STEEL CONNECTION MATERIALS

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

## 2.8 BEARING PADS

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

- and Resistance Factor Design (LRFD) Bridge Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
4. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to stainless- or mild-steel plate, of type required for in-service stress.
  5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

## 2.9 GROUT MATERIALS

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

## 2.10 THIN-BRICK UNITS AND ACCESSORIES

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

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

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

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

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

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

## 2.11 STONE MATERIALS AND ACCESSORIES

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

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

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

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

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

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

## 2.12 INSULATED FLAT WALL PANEL ACCESSORIES

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

## 2.13 CONCRETE MIXTURES

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

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

## 2.14 MOLD FABRICATION

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

## 2.15 THIN-BRICK FACINGS

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

## 2.16 STONE FACINGS

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



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

## 2.17 FABRICATION

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

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

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

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

## 2.18 CASTING INSULATED WALL PANELS

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

## 2.19 FABRICATION TOLERANCES

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

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

## 2.20 COMMERCIAL FINISHES

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

## 2.21 COMMERCIAL ARCHITECTURAL FINISHES

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

[sample panels] [mockups] and as follows:

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

## 2.22 SOURCE QUALITY CONTROL

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

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

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

### 3.2 INSTALLATION

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

at random by calibrated torque wrench.

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

### 3.3 ERECTION TOLERANCES

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

### 3.4 FIELD QUALITY CONTROL

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



### 3.5 REPAIRS

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

### 3.6 CLEANING

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

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 034100

## SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:

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

- B. Related Sections include the following:

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

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

#### 1.3 DEFINITION

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

## 1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

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

## 1.5 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

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

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

## 1.6 INFORMATIONAL SUBMITTALS

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

## 1.7 CLOSEOUT SUBMITTALS

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

## 1.8 QUALITY ASSURANCE

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

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

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

- K. Mockups: After sample panel[ **and range sample**] approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup as indicated on Drawings including [**aluminum framing, glass, sealants,**] **<Insert construction>** and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
  2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by DEN Project Manager in writing.
- L. Preconstruction Testing Mockup: Provide a full-size mockup of architectural precast concrete indicated on Drawings for preconstruction testing. Refer to Division **[01] [08]** **<Insert Division number>** Section "**<Insert Section title>**" for preconstruction testing requirements.
1. Build preconstruction testing mockup as indicated on Drawings including [**aluminum framing, glass, sealants,**] **<Insert construction>** and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
  2. Build preconstruction testing mockup at testing agency facility.
- M. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** to comply with requirements in Section 013100 "Project Management And Coordination."
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
  - B. Support units during shipment on nonstaining shock-absorbing material.
  - C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
  - D. Place stored units so identification marks are clearly visible, and units can be inspected.
  - E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
  - F. Lift and support units only at designated points shown on Shop Drawings.



## 1.10 SEQUENCING

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

## 1.11 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 MOLD MATERIALS

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

## 2.3 REINFORCING MATERIALS

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

## 2.4 PRESTRESSING TENDONS

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

## 2.5 CONCRETE MATERIALS

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

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

## 2.6 STEEL CONNECTION MATERIALS

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

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

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

## 2.8 BEARING PADS

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

## 2.9 ACCESSORIES

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

## 2.10 GROUT MATERIALS

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

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

## 2.11 THIN BRICK UNITS AND ACCESSORIES

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

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

## 2.12 STONE MATERIALS AND ACCESSORIES

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

## 2.13 INSULATED PANEL ACCESSORIES

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

## 2.14 CONCRETE MIXTURES

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



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

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

## 2.15 MOLD FABRICATION

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

## 2.16 THIN BRICK FACINGS

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

## 2.17 STONE FACINGS

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

## 2.18 FABRICATION

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

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

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

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

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

## 2.21 FINISHES

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

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

## 2.22 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.
1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

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

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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



## 3.2 INSTALLATION

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

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

### 3.3 ERECTION TOLERANCES

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

### 3.4 FIELD QUALITY CONTROL

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

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

### 3.5 REPAIRS

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

### 3.6 CLEANING

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

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 034500

## SECTION 055300 - METAL GRATINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal bar gratings.
2. Expanded-metal gratings.
3. Formed-metal plank gratings.
4. Extruded-aluminum plank gratings.
5. Glass-fiber-reinforced plastic gratings.
6. Metal frames and supports for gratings.

- B. Related Sections:

1. Section 050510 "Welding" for general welding requirements.
2. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
3. Section 055100 "Metal Stairs" for grating treads and landings of steel-framed stairs.
4. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

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

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  1. Floors: Uniform load of **125 lbf/sq. ft.** (6.00 kN/sq. m) or concentrated load of **2000 lbf** (8.90 kN), whichever produces the greater stress.

2. Floors: Uniform load of **250 lbf/sq. ft.** (11.97 kN/sq. m) or concentrated load of **3000 lbf** (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of **60 lbf/sq. ft.** (2.87 kN/sq. m).
4. Walkways and Elevated Platforms Used as Exits: Uniform load of **100 lbf/sq. ft.** (4.79 kN/sq. m).
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of **250 lbf/sq. ft.** (11.97 kN/sq. m) or concentrated load of **8000 lbf** (35.60 kN), whichever produces the greater stress.
6. Limit deflection to **[L/240] [L/360] <Insert deflection ratio>** or **1/4 inch** (6.4 mm), whichever is less.

- C. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Glass-fiber-reinforced plastic gratings.
4. Clips and anchorage devices for gratings.
5. Paint products.
6. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include plans, sections, details, and attachments to other work.

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

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

- B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

#### 1.6 CLOSEOUT SUBMITTALS

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

#### 1.7 QUALITY ASSURANCE

- A. Metal Bar Grating Standards: Comply with **[NAAMM MBG 531, "Metal Bar Grating Manual]" and [NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual]."**
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
  - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

#### 1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** <Insert number> percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- D. Wire Rod for Bar Grating Crossbars: [ASTM A 510](#) (ASTM A 510M).
- E. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, [Grade 30](#) (Grade 205).
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, [Grade 33](#) (Grade 230), with [G90](#) (Z275) coating.
- G. Expanded-Metal Carbon Steel: ASTM F 1267, Class 1.
- H. Expanded-Metal Galvanized Steel: ASTM F 1267, Class 2, Grade A.
- I. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, **[Type 304]** **[Type 316]**.
- J. Stainless-Steel Bars and Shapes: ASTM A 276, **[Type 304]** **[Type 316]**.
- K. Expanded-Metal Stainless Steel: ASTM F 1267, Class 3, made from stainless-steel sheet, ASTM A 666, **[Type 304]** **[Type 316]**.

### 2.2 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: [ASTM B 221](#) (ASTM B 221M), alloys as follows:
  - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
  - 2. 6061-T1, for grating crossbars.



- C. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), Alloy 5052-H32.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide [**Type 304**] [**Type 316**] stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); with hex nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.

- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy [**Group 1 (A1)**] [**Group 2 (A4)**].

- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

- E. Plain Washers: Round, [ASME B18.22.1](#) (ASME B18.22M).

- F. Lock Washers: Helical, spring type, [ASME B18.21.1](#) (ASME B18.21.2M).

- G. Post-Installed Anchors: [**Torque-controlled expansion anchors**] [**or**] [**chemical anchors**] capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Primers: Provide primers that comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
    - b. or approved equal.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately  $1/32$  inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Reference Section 050510 "Welding" for general welding requirements. Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: **4 inches** (100 mm) unless otherwise indicated.

## 2.6 METAL BAR GRATINGS

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

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
3. BarnettBates Corporation.
4. Borden Metal Products (Canada) Limited.
5. Fisher & Ludlow; Division of Harris Steel Limited.
6. Grating Pacific, Inc.
7. Grupo Metelmex, S.A. de C.V.
8. IKG Industries; a division of Harsco Corporation.
9. Marwas Steel Co.; Laurel Steel Products Division.
10. Ohio Gratings, Inc.
11. Seidelhuber Metal Products; Division of Brodhead Steel Products.
12. **<Insert manufacturer's name>**.
13. or approved equal.

B. Welded Steel Grating [**MBG-#>**]:

1. Bearing Bar Spacing: [**7/16 or 1/2 inch** (11 or 13 mm)] [**11/16 inch** (17 mm)] [**15/16 inch** (24 mm)] [**1-3/16 inches** (30 mm)] [**1-3/8 inches** (35 mm)] [**1-7/8 inches** (48 mm)] [**2-3/8 inches** (60 mm)] **<Insert dimension(s)>** o.c.
2. Bearing Bar Depth: [**3/4 inch** (19 mm)] [**1 inch** (25 mm)] [**1-1/4 inches** (32 mm)] [**1-1/2 inches** (38 mm)] [**1-3/4 inches** (44 mm)] [**2 inches** (51 mm)] [**2-1/4 inches** (57 mm)] [**2-1/2 inches** (64 mm)] [**3 inches** (76 mm)] [**3-1/2 inches** (89 mm)] [**4 inches** (102 mm)] [**4-1/2 inches** (114 mm)] [**5 inches** (127 mm)] [**As required to comply with structural performance requirements**].
3. Bearing Bar Thickness: [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] [**3/8 inch** (9.5 mm)] [**As required to comply with structural performance requirements**].
4. Crossbar Spacing: [**2 inches** (51 mm)] [**4 inches** (102 mm)] o.c.
5. Grating Mark W-11-4 (1 x 3/16) STEEL: **1-by-3/16-inch** (25-by-4.8-mm) bearing bars at **11/16 inch** (18 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.
6. Grating Mark W-15-4 (1 x 1/8) STEEL: **1-by-1/8-inch** (25-by-3.2-mm) bearing bars at **15/16 inch** (24 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.

7. Grating Mark W-19-4 (1-1/4 x 3/16) STEEL: 1-1/4-by-3/16-inch (32-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  8. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  9. Grating Mark W-19-4 (2 x 1/4) STEEL: 2-by-1/4-inch (51-by-6.4-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  10. Grating Mark W-30-4 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars at 1-7/8 inches (60 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  11. Grating Mark: As indicated.
  12. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
  13. Steel Finish: **[Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface]**.
- C. Pressure-Locked Steel Grating **[MBG-<#>]**: Fabricated by **[pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars]**.
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
  2. Bearing Bar Depth: **[3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements] <Insert depth>.**
  3. Bearing Bar Thickness: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [As required to comply with structural performance requirements] <Insert thickness>.**
  4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
  5. Grating Mark P-11-4 (1 x 3/16) STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  6. Grating Mark P-15-4 (1-1/4 x 1/8) STEEL: 1-1/4-by-1/8-inch (32-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  7. Grating Mark P-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  8. Grating Mark: As indicated.
  9. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
  10. Steel Finish: **[Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface]**.
- D. Riveted Steel Grating **[MBG-<#>]**:
1. Bearing Bar Spacing: **[3/4 inch (19 mm)] [1-1/8 inches (29 mm)] [2-5/16 inches (59 mm)] <Insert dimension>, clear.**
  2. Bearing Bar Depth: **[3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57**

- mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [3-1/2 inches (89 mm)] [4 inches (102 mm)] [4-1/2 inches (114 mm)] [5 inches (127 mm)] [**As required to comply with structural performance requirements**].
3. Bearing Bar Thickness: [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [**As required to comply with structural performance requirements**].
  4. Rivet Spacing: [3-1/2 inches (89 mm)] [5 inches (127 mm)] [7 inches (178 mm)] o.c. along bearing bar.
  5. Grating Mark R-12-3-1/2 (1 x 1/8) STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars with 3/4-inch (19-mm) clear space between bearing bars, and rivets at 3-1/2 inches (89 mm) o.c. along bearing bar.
  6. Grating Mark R-18-7 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars with 1-1/8-inch (29-mm) clear space between bearing bars, and rivets at 7 inches (178 mm) o.c. along bearing bar.
  7. Grating Mark R-37-5 (4 x 1/4) STEEL: 4-by-1/4-inch (102-by-6.4-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
  8. Grating Mark R-37-5 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
  9. Grating Mark: As indicated.
  10. Traffic Surface: [Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [**As indicated**].
  11. Steel Finish: [Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface].
- E. Pressure-Locked, Stainless-Steel Grating [**MBG-<#>**]: Fabricated by [pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars].
1. Bearing Bar Spacing: [7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] [1-3/8 inches (35 mm)] [1-7/8 inches (48 mm)] [2-3/8 inches (60 mm)] <Insert dimension(s)> o.c.
  2. Bearing Bar Depth: [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [3-1/2 inches (89 mm)] [4 inches (102 mm)] [4-1/2 inches (114 mm)] [5 inches (127 mm)] [**As required to comply with structural performance requirements**].
  3. Bearing Bar Thickness: [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [**As required to comply with structural performance requirements**].
  4. Crossbar Spacing: [2 inches (51 mm)] [4 inches (102 mm)] o.c.
  5. Grating Mark P-11-4 (1 x 3/16) STAINLESS STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  6. Grating Mark P-15-2 (1 x 1/8) STAINLESS STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 2 inches (51 mm) o.c.

7. Grating Mark P-19-4 (1-1/2 x 3/16) STAINLESS STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  8. Grating Mark P-30-4 (3 x 3/8) STAINLESS STEEL: 3-by-3/8-inch (76-by-9.5-mm) bearing bars at 1-7/8 inches (48 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  9. Grating Mark: As indicated.
  10. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated].**
  11. Finish: **[Mill finish] [Abrasive blasted] [Electropolished].**
- F. Pressure-Locked, Rectangular Bar Aluminum Grating **[MBG-<#>]**: Fabricated by **[pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars].**
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17.5 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
  2. Bearing Bar Depth: **[1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements].**
  3. Bearing Bar Thickness: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [As required to comply with structural performance requirements].**
  4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
  5. Grating Mark P-7-4 (1 x 1/8) ALUMINUM: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 7/16 inch (11 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  6. Grating Mark P-11-4 (1 x 3/16) ALUMINUM: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  7. Grating Mark P-15-4 (1-1/2 x 3/16) ALUMINUM: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  8. Grating Mark P-19-4 (2 x 3/16) ALUMINUM: 2-by-3/16-inch (51-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
  9. Grating Mark: As indicated.
  10. Traffic Surface: **[Plain] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated].**
  11. Aluminum Finish: **[Mill finish] [Class I, clear, anodized finish].**
- G. Pressure-Locked, Aluminum I-Bar Grating **[MBG-<#>]**: Fabricated by swaging crossbars between bearing bars.
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
  2. Bearing Bar Depth: **[1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements].**
  3. Bearing Bar Flange Width: **1/4 inch (6.4 mm).**
  4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
  5. Grating Mark P-11-4 (1 I-Bar) ALUMINUM: 1-inch (25-mm) I-bar bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.

6. Grating Mark P-15-2 (1 I-Bar) ALUMINUM: **1-inch** (25-mm) I-bar bearing bars at **15/16 inch** (24 mm) o.c., and crossbars at **2 inches** (51 mm) o.c.
  7. Grating Mark P-19-4 (1-1/2 I-Bar) ALUMINUM: **1-1/2-inch** (38-mm) I-bar bearing bars at **1-3/16 inches** (30 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.
  8. Grating Mark: As indicated.
  9. Traffic Surface: **[Plain] [Grooved] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
  10. Aluminum Finish: **[Mill finish] [Class I, clear, anodized finish]**.
- H. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
  2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars **3/16 inch** (4.8 mm) or less in thickness and spaced **15/16 inch** (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
  3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars **3/16 inch** (4.8 mm) or less in thickness and spaced less than **15/16 inch** (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
  4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
  5. Furnish threaded bolts with nuts and washers for securing grating to supports.
  6. Furnish self-drilling fasteners with washers for securing grating to supports.
  7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
- a. Products: Subject to compliance with requirements, provide one of the following:
- 1) Kee Industrial Products, Inc.; Grating Clip.
  - 2) Lindapter North America, Inc.; Grate-Fast.
  - 3) **<Insert manufacturer's name; product name or designation>**.
  - 4) or approved equal.
- I. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- J. Do not notch bearing bars at supports to maintain elevation.

## 2.7 EXPANDED-METAL GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  2. All American Grating.
  3. Central Expanded Metal, Inc.
  4. Fisher & Ludlow; Division of Harris Steel Limited.
  5. Grating Pacific, Inc.
  6. **<Insert manufacturer's name>**.
  7. or approved equal.
- B. Provide expanded-metal gratings in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
1. Material: [**Steel**] [**Stainless steel**] [**Aluminum**].
  2. Steel Finish: [**Unfinished, oiled**] [**Shop primed**] [**Galvanized**].
  3. Stainless-Steel Finish: Mill finish, as fabricated.
  4. Aluminum Finish: Mill finish, as fabricated.
  5. Style Designation: [**4.27 lb**] [**3/4 number 9**].
  6. Style Designation: [**1-1/2 number 9**] [**3/4 number 9**].
  7. Size: [**2 lb**] [**3/4 0.188**] [**1-1/2 0.125**].
  8. Type: [**I, expanded**] [**II, expanded and flattened**].
- C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with bars having a thickness not less than overall grating thickness at contact points.
- D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than **1/8 inch** (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

## 2.8 FORMED-METAL PLANK GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  2. Fisher & Ludlow; Division of Harris Steel Limited.
  3. Grating Pacific, Inc.
  4. GS Metals Corp.
  5. IKG Industries; a division of Harsco Corporation.
  6. Morton Manufacturing Company.
  7. Unistrut.
  8. **<Insert manufacturer's name>**.



9. or approved equal.
- B. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alabama Metal Industries Corporation, a Gibraltar Industries company; Diamond Grip.
    - b. Fisher & Ludlow, Division of Harris Steel Limited; Grip Span.
    - c. GS Metals Corp.; Grip Strut.
    - d. IKG Industries, a division of Harsco Corporation; Deck Span.
    - e. Morton Manufacturing Company; Grip-Tac.
    - f. **<Insert manufacturer's name; product name or designation>**.
    - g. or approved equal.
  2. Channel Width: [4-3/4 inches (121 mm)] [7 inches (178 mm)] [9-1/2 inches (241 mm)] [11-3/4 inches (298 mm)] [18-3/4 inches (476 mm)] [24 inches (610 mm)] [**As indicated**] [**As required to comply with structural performance requirements**].
  3. Channel Depth: [1-1/2 inches (38 mm)] [2 inches (51 mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [**As indicated**] [**As required to comply with structural performance requirements**].
  4. Material: [0.074-inch- (1.9-mm-) **thick steel sheet, shop primed**] [0.104-inch- (2.65-mm-) **thick steel sheet, shop primed**] [0.079-inch- (2.0-mm-) **thick, hot-dip galvanized-steel sheet**] [0.108-inch- (2.8-mm-) **thick, hot-dip galvanized-steel sheet**] [0.074-inch- (1.9-mm-) **thick steel sheet, hot-dip galvanized after fabrication**] [0.104-inch- (2.65-mm-) **thick steel sheet, hot-dip galvanized after fabrication**] [0.062-inch- (1.6-mm-) **thick, stainless-steel sheet**] [0.078-inch- (2.0-mm-) **thick, stainless-steel sheet**] [0.080-inch- (2.0-mm-) **thick aluminum sheet**] [0.100-inch- (2.5-mm-) **thick aluminum sheet**].
- C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.
- D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.
- 2.9 EXTRUDED-ALUMINUM PLANK GRATINGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  2. IKG Industries; a division of Harsco Corporation.

3. Ohio Gratings, Inc.
  4. Seidelhuber Metal Products; Division of Brodhead Steel Products.
  5. **<Insert manufacturer's name>**.
  6. or approved equal.
- B. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
1. Type: Extruded-aluminum planks approximately **6 inches** (152 mm) wide with multiple flanges approximately **1.2 inches** (30 mm) o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised ribs to increase slip resistance.
  2. Depth: [**1 inch** (25 mm)] [**1-1/2 inches** (38 mm)] [**2 inches** (51 mm)] [**As required to comply with structural performance requirements**].
  3. Perforations: [**None**] [**Rectangular, 19/32 by 3 inches** (15 by 76 mm), **with adjacent rows staggered**] [**19/32 inch** (15 mm) **square, with adjacent rows aligned**].
  4. Finish: Mill finish, as fabricated.
- C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

## 2.10 GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Grating, LLC.
  2. Creative Pultrusions, Inc.
  3. Enduro Systems Inc.; Composite Products Division.
  4. Fibergrate Composite Structures Inc.
  5. Fisher & Ludlow; Division of Harris Steel Limited.
  6. Grating Pacific, Inc.
  7. Seasafe, Inc.; a Gibraltar Industries company.
  8. Strongwell Corporation.
  9. **<Insert manufacturer's name>**.
  10. or approved equal.
- B. Molded Glass-Fiber-Reinforced Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.
1. Configuration: [**1-1/2-inch-** (38-mm-) **square mesh, 1 inch** (25 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, 1-1/4 inches** (32 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, 1-1/2 inches** (38 mm) **thick**] [**2-inch-** (51-mm-) **square mesh, 2 inches** (51 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, thickness as required to comply with structural performance requirements**] [**As required**]

**to comply with structural performance requirements] <Insert configuration>.**

2. Weight: [2.5 lb/sq. ft. (12.2 kg/sq. m)] [2.7 lb/sq. ft. (13.2 kg/sq. m)] [3.2 lb/sq. ft. (15.6 kg/sq. m)] [3.5 lb/sq. ft. (17.1 kg/sq. m)] [3.7 lb/sq. ft. (18.1 kg/sq. m)] [4.1 lb/sq. ft. (20.0 kg/sq. m)] [5.0 lb/sq. ft. (24.4 kg/sq. m)] <Insert value>.
  3. Resin: [Polyester] [Vinylester] <Insert description>.
    - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
    - b. U.S.D.A. Acceptance: Accepted for food-processing applications.
  4. Color: [Beige] [Gray] [Green] [Orange] [Yellow] [Manufacturer's standard].
  5. Traffic Surface: [Plain, meniscus] [Applied abrasive finish] [As indicated].
- C. Pultruded Glass-Fiber-Reinforced Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.
1. Configuration: [I4010; 1-inch (25-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open)] [I6010; 1-inch (25-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open)] [I4015; 1-1/2-inch (38-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open)] [I6015; 1-1/2-inch (38-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open)] [T3320; 2-inch (51-mm) T-bars spaced 1-1/2 inches (38 mm) o.c. (33 percent open)] [T5020; 2-inch (51-mm) T-bars spaced 2 inches (51 mm) o.c. (50 percent open)] [As required to comply with structural performance requirements] <Insert configuration>.
  2. Weight: [2.35 lb/sq. ft. (11.5 kg/sq. m)] [2.83 lb/sq. ft. (13.8 kg/sq. m)] [3.10 lb/sq. ft. (15.1 kg/sq. m)] [3.41 lb/sq. ft. (16.6 kg/sq. m)] [4.10 lb/sq. ft. (20.0 kg/sq. m)] [4.13 lb/sq. ft. (20.2 kg/sq. m)] <Insert value>.
  3. Resin Type: [Polyester] [Vinylester] <Insert description>.
    - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
    - b. U.S.D.A. Acceptance: Accepted for food processing applications.
  4. Color: [Beige] [Gray] [Green] [Orange] [Yellow] [Manufacturer's standard].
  5. Traffic Surface: [Plain, grooved] [Applied abrasive finish] [As indicated].
- D. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

## 2.11 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors **24 inches** (600 mm) o.c. and provide minimum anchor units in the form of steel straps **1-1/4 inches** (32 mm) wide by **1/4 inch** (6 mm) thick by **8 inches** (200 mm) long.
- B. Frames and Supports for Glass-Fiber-Reinforced Plastic Gratings: Fabricate from glass-fiber-reinforced plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, use shapes made from same resin as gratings.
  2. Equip units indicated to be cast into concrete or built into masonry with integral anchors.
- C. Galvanize steel frames and supports in the following locations:
1. Exterior.
  2. Interior[, **where indicated**].

## 2.12 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

## 2.13 STEEL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish gratings, frames, and supports after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- D. Shop prime gratings, frames and supports[ **not indicated to be galvanized**] unless otherwise indicated.
1. Shop prime with [**universal shop primer**] [**primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"**] unless [**zinc-rich primer is**] [**primers specified in Section 099600 "High-Performance Coatings" are**] indicated.

- E. Preparation for Shop Priming: Prepare surfaces to comply with [**SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."**] [**SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."**] [**requirements indicated below:**]
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- F. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Reference Section 050510 "Welding" for general welding requirements. Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.

- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### 3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

### 3.3 INSTALLING EXPANDED-METAL GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings.
- B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.
- C. Attach removable units to supporting members by bolting at **6-inch** (150-mm) intervals.
- D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at **6-inch** (150-mm) intervals.
- E. Attach aluminum units to steel supporting members by bolting at **6-inch** (150-mm) intervals.
- F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

### 3.4 INSTALLING METAL PLANK GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.
- B. Attach removable units to supporting members by bolting at every point of contact.
- C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

- D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

### 3.5 INSTALLING GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

- 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 055300

## SECTION 055813 - COLUMN COVERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes [**spackled-seam**] [**and**] [**snap-together**] metal column covers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For [**adhesives**] [**and**] [**sealants**], documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit IEQ 4.1: For [**adhesives**] [**and**] [**sealants**], documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - 3. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for column covers.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].
- E. Samples for Verification: For each type of exposed finish required, prepared on **6-inch-**  
(150-mm-) square Samples of metal of same thickness and material indicated for the Work.



1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[fabricator] [organic-coating applicator] [anodic finisher] [and] [powder-coating applicator]**.
- B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For **[mirrorlike stainless-steel finish] [and] [statuary conversion coating copper-alloy finish]** to include in maintenance manuals.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups of typical column covers.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

1.9 CONSTRUCTION WASTE MANAGEMENT

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

**PART 2 - PRODUCTS**

2.1 SPACKLED-SEAM COLUMN COVERS

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

1. [Fry Reglet Corporation.](#)
2. [MM Systems Corporation.](#)
3. [Pittcon Industries.](#)
4. **<Insert manufacturer's name>.**
5. or approved equal.

- B. Form column covers from **0.125-inch (3.2-mm)** aluminum sheet complying with **ASTM B 209 (ASTM B 209M)**, with not less than strength and durability properties of Alloy 5005-H32; rolled to radii indicated. Taper edges of adjoining pieces of column covers, for taping and spackling, to **0.094-inch (2.4-mm)** thickness in approximately **1 inch (25 mm)** of width. Punch tapered edges for gypsum board screws at **1/2 inch (12 mm)** o.c., and mill grooves in tapered edge to improve bond with joint compound.

1. Support Framing: At vertical joints, provide **1-1/2-by-3-5/8-inch (38-by-89-mm)** steel channel support posts formed from **0.040-inch (1.0-mm)** galvanized steel.
2. Joint Treatment Materials: Provide joint treatment compounds and reinforcing tape complying with requirements in Section 092900 "Gypsum Board."

2.2 SNAP-TOGETHER COLUMN COVERS

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

1. [ATAS International, Inc.](#)
2. [Ceilings Plus.](#)
3. [Construction Services, Inc.](#)
4. [Firestone Metal Products, LLC; Una-Clad.](#)
5. [Fry Reglet Corporation.](#)

6. [Hi-Tech Metals, Inc.](#)
7. [Industrial Louvers Inc.](#)
8. [Kanalco Ltd.](#)
9. [Leed Himmel Industries, Inc.](#)
10. [Metal Sales & Service, Inc.; Metalwerks Division.](#)
11. [MM Systems Corporation.](#)
12. [Pittcon Industries.](#)
13. [Protean Construction Products, Inc.](#)
14. [Southwest Metalsmiths.](#)
15. <Insert manufacturer's name>.
16. or approved equal.

B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), with not less than strength and durability properties of Alloy 5005-H32, [[0.063 inch](#) (1.60 mm)] <Insert dimension> thick.
  - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
2. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed, [[0.060 inch](#) (1.52 mm)] <Insert dimension> thick.
  - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
3. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316**], [[0.050 inch](#) (1.27 mm)] <Insert dimension> thick.
  - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].
4. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS C28000 (muntz metal, 60 percent copper) or Alloy UNS C23000 (red brass, 85 percent copper), [[0.051 inch](#) (1.29 mm)] <Insert dimension> thick.
  - a. Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Statuary conversion coating over satin finish**].
5. Brass Sheet: ASTM B 36/B 36M, Alloy UNS C26000 (cartridge brass, 70 percent copper), [[0.051 inch](#) (1.29 mm)] <Insert dimension> thick.
  - a. Finish: [**Buffed**] [**Hand-rubbed**] finish, lacquered.
6. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
7. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.

8. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
9. Form returns at vertical joints to provide hairline V-joints.
10. Form returns at vertical joints to provide [~~1/2-inch- (12-mm-)~~] [~~3/4-inch- (18-mm-)~~] wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals [~~1/2 inch (12 mm) deep~~] [~~flush~~].
11. Form returns at vertical joints to accommodate backer rod and sealant.
12. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
13. Fabricate column covers without horizontal joints.
14. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
15. Fabricate column covers with [~~1/2-inch- (12-mm-)~~ **wide**] reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
16. Fabricate [**base**] [**ceiling**] ring to [**match**] [**contrast with**] column covers.
17. Fabricate with calk stop/stiffener ring.
18. Apply manufacturer's recommended sound-deadening [**insulation**] [**mastic**] to backs of column covers.

## 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
  1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless[ **otherwise indicated**][ **exposed fasteners are unavoidable or are the standard fastening method**].
  2. Provide [**Phillips**] [**tamper-resistant**] [**square or hex socket**] flat-head machine screws for exposed fasteners unless otherwise indicated.
- B. Sound-Deadening Materials:
  1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
  2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Backing Materials: Provided or recommended by column cover manufacturer.

## 2.4 PAINTS AND COATINGS

- A. Low-Emitting Materials: Paints and coatings applied to interior decorative formed metal items shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- B. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.
- C. Shop Primers: Comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- D. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.5 FABRICATION, GENERAL

- A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
  2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- D. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- F. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- 2.8 STEEL SHEET FINISHES
- A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
  - B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

- C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- D. Baked-Enamel Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils** (0.05 mm).
  - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- E. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
  - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

## 2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- D. Directional Satin Finish: No. 4.
- E. Dull Satin Finish: No. 6.
- F. Satin, Reflective, Directional Polish: No. 7.
- G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

## 2.10 COPPER-ALLOY FINISHES

- A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).
  1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- C. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
  1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
- E. Apply joint treatment at joints of spackled-seam metal column covers. Comply with requirements in Section 092900 "Gypsum Board."



### 3.3 ADJUSTING AND CLEANING

- A. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- B. Touchup Painting: Immediately after erection, clean abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of shop paint are specified in **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting" Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

### 3.4 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 055813

## SECTION 057300 - DECORATIVE METAL RAILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Aluminum decorative railings[ **with stainless-steel, wire-rope guard infill**].
2. Copper-alloy decorative railings.
3. Stainless-steel decorative railings[ **with stainless-steel, wire-rope guard infill**].
4. Steel and iron decorative railings[ **with stainless-steel, wire-rope guard infill**].
5. Glass- and plastic-supported railings.
6. Post-supported railings with glass infill.
7. Illuminated decorative railings.

B. Related Sections:

1. Section 055100 "Metal Stairs" for steel tube railings included with metal stairs.
2. Section 055213 "Pipe and Tube Railings" for railings fabricated from pipe and tube components.
3. Section 057500 "Decorative Formed Metal" for other decorative formed metal items.
4. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood blocking for anchoring railings.
5. **[Section 062013 "Exterior Finish Carpentry"] [Section 062023 "Interior Finish Carpentry"] [Section 064023 "Interior Architectural Woodwork"]** for wood railings.
6. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

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

#### 1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
  2. Copper Alloys: 60 percent of minimum yield strength.
  3. Stainless Steel: 60 percent of minimum yield strength.
  4. Steel: 72 percent of minimum yield strength.
  5. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Design, engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems. Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 100 **lbf/ft.** (1.46 kN/m) applied in any direction.
    - b. Concentrated load of 300 **lbf** (1.34 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards: Capable of withstanding a horizontal concentrated load at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
    - a. Concentrated load of 200 **lbf** (0.88 kN) applied horizontally on an area of 1 **sq. ft.** (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: **120 deg F** (67 deg C), ambient; **180 deg F** (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

## 1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made **[by Owner] [from the testing and inspecting allowance, as authorized by Change Orders] [by Contractor]**. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E 894 and ASTM E 935.
3. Notify DEN Project Manager **[seven] <Insert number>** days in advance of the dates and times when laboratory mockups will be tested.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.
3. Finishing materials and methods, and detailed sequence of installation.
4. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that wood rails comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Laboratory Test Reports for Credit IEQ 4: For paints and coatings on interior decorative metal items, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Indicate materials, profiles of each ornamental metalwork member and fitting, joinery, finishes, fasteners, anchorages and accessory items.
  - 1. Include setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as unit of Work of other sections.
  - 2. For illuminated railings, include wiring diagrams and roughing-in details.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].
- E. Samples for Verification: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Each type of glass required.
  - 3. Fittings and brackets.
  - 4. Welded connections.
  - 5. Brazed connections.
  - 6. Assembled Samples of entire section of each type of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections.
- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**professional engineer**] [**testing agency**].
- B. Qualification data for firms and persons specified "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Owners, plus other information specified.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Installer certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.
- E. Welding certificates.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- G. Preconstruction test reports.

## 1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing ornamental metalwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of ornamental work specified in this section by same firm that fabricated them.
- C. Testing for recertification is Contractor's responsibility.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of assemblies similar in material, design, and extent to that indicated for this Project.
- E. Field Test: Field test mock-up per structural requirements indicated. DEN Project Manager to be present during testing.
- F. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- G. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
  - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- H. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- I. Welding Qualifications: Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification. Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- J. Safety Glazing Labeling: Permanently mark glass with certification label of **[the SGCC]** **[the SGCC or another certification agency acceptable to authorities having jurisdiction]** **[or]** **[manufacturer]**. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups as shown on Drawings.
  2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than **24 inches** (600 mm) in length.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- M. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**

## 1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Do not delay job progress; allow for adjustments and fitting where taking of field measurements before fabrication might delay Work.

## 1.10 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Store components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that permits air circulation within covering.
- B. Handle ornamental work on site to a minimum; exercise care to avoid damaging metal finishes.

1.12 CONSTRUCTION WASTE MANAGEMENT

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

**PART 2 - PRODUCTS**

2.1 METALS

- A. General: Provide ornamental work composed of forms and types which comply with requirements of referenced standards and which are free from surface blemishes where exposed to view in the finished unit. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, "oil canning," stains, discolorations or other imperfections on finished units are not acceptable.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aluminum Decorative Railings:
    - a. Architectural Metal Works.
    - b. Architectural Railings & Grilles, Inc.
    - c. ATR Technologies, Inc.
    - d. Blum, Julius & Co., Inc.
    - e. Blumcraft of Pittsburgh.
    - f. Braun, J. G., Company; a division of the Wagner Companies.
    - g. CraneVeyor Corp.
    - h. Laurence, C. R. Co., Inc.
    - i. Livers Bronze Co.
    - j. Newman Brothers, Inc.
    - k. Pisor Industries, Inc.
    - l. Platers Polishing Company; a division of Rippel Architectural Metals.
    - m. Poma Corporation.
    - n. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
    - o. Superior Aluminum Products, Inc.



- p. Wagner, R & B, Inc.; a division of the Wagner Companies.
  - q. Wylie Systems.
  - r. **<Insert manufacturer's name>**.
  - s. or approved equal.
2. Copper-Alloy Decorative Railings:
- a. Architectural Metal Works.
  - b. Blum, Julius & Co., Inc.
  - c. Blumcraft of Pittsburgh.
  - d. Braun, J. G., Company; a division of the Wagner Companies.
  - e. CraneVeyor Corp.
  - f. Lavi Industries.
  - g. Livers Bronze Co.
  - h. Newman Brothers, Inc.
  - i. Platers Polishing Company; a division of Rippel Architectural Metals.
  - j. Tri Tech, Inc.
  - k. Wagner, R & B, Inc.; a division of the Wagner Companies.
  - l. Wylie Systems.
  - m. **<Insert manufacturer's name>**.
  - n. or approved equal.
3. Stainless-Steel Decorative Railings:
- a. Architectural Metal Works.
  - b. Architectural Railings & Grilles, Inc.
  - c. Atlantis Rail Systems; Division of Suncor Stainless.
  - d. Blum, Julius & Co., Inc.
  - e. Blumcraft of Pittsburgh.
  - f. CraneVeyor Corp.
  - g. Livers Bronze Co.
  - h. Newman Brothers, Inc.
  - i. P & P Artec.
  - j. Pisor Industries, Inc.
  - k. Platers Polishing Company; a division of Rippel Architectural Metals.
  - l. Tri Tech, Inc.
  - m. Wagner, R & B, Inc.; a division of the Wagner Companies.
  - n. Wylie Systems.
  - o. **<Insert manufacturer's name>**.
  - p. or approved equal.
4. Stainless-Steel and Glass Decorative Railings:
- a. Architectural Arts Mfg., Inc.
  - b. Julius Blum & Co., Inc.
  - c. Downey Architectural Systems
  - d. Zephyr Metal Craft, Inc.
  - e. Tri-Tech, Inc.
  - f. Rippel Architectural Metals, Inc.
  - g. Newman Brothers, Inc.

- h. Livers Bronse Co., Inc.
  - i. Lavi Industries
  - j. York Metal Fabricators, Inc.
  - k. Custom Enclosures, Inc.
  - l. Clover Glazing Corp., Clear View Rail
  - m. Clearail, Inc.
  - n. **<Insert manufacturer>**
  - o. or approved equal.
5. Steel and Iron Decorative Railings:
- a. Architectural Iron Designs, Inc.
  - b. Artezzi.
  - c. Bavarian Iron Works Co.; TT Triebenbacher.
  - d. Blum, Julius & Co., Inc.
  - e. Braun, J. G., Company; a division of the Wagner Companies.
  - f. Indital USA; a division of Ind.i.a. SPA.
  - g. Lawler Foundry Corporation.
  - h. Livers Bronze Co.
  - i. Olin Wrought Iron.
  - j. Regency Railings.
  - k. Wagner, R & B, Inc.; a division of the Wagner Companies.
  - l. Wiemann Ironworks.
  - m. **<Insert manufacturer's name>**.
  - n. or approved equal.
6. Glass- and Plastic-Supported Railings:
- a. Architectural Metal Works.
  - b. Blum, Julius & Co., Inc.
  - c. Blumcraft of Pittsburgh.
  - d. Clearail, Inc.
  - e. CraneVeyor Corp.
  - f. Livers Bronze Co.
  - g. Newman Brothers, Inc.
  - h. Platers Polishing Company; a division of Rippel Architectural Metals.
  - i. TACO Metals Inc.
  - j. Tri Tech, Inc.
  - k. **<Insert manufacturer's name>**.
  - l. or approved equal.
7. Illuminated Decorative Railings:
- a. Blumcraft of Pittsburgh.
  - b. Cole, C. W., & Company, Inc.
  - c. L & J Specialty Corp.; Lumirail Division.
  - d. **<Insert manufacturer's name>**.
  - e. or approved equal.

## 2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
  - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
  - 3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
  - 4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

## 2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes[, **Including Extruded Tubing**]: [ASTM B 221](#) (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural [**Pipe**] [**and**] [**Round Tubing**]: ASTM B 429/B 429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: [ASTM B 210](#) (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: [ASTM B 209](#) (ASTM B 209M), [**Alloy 5005-H32**] [**Alloy 6061-T6**].
- F. Die and Hand Forgings: [ASTM B 247](#) (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Perforated Metal: Aluminum sheet, [ASTM B 209](#) (ASTM B 209M), Alloy 6061-T6, [0.063 inch (1.60 mm)] <Insert thickness> thick, [**with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows**] <Insert description>.
  - 1. Basis-of-Design Product: Provide product with perforations matching <Insert manufacturer's name; product name or designation>.
- I. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch (4.1-mm) nominal diameter wire complying with [ASTM B 211](#) (ASTM B 211M), Alloy 6061-T94.

## 2.5 COPPER ALLOYS

- A. Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars and Temper H55 (light drawn) for tube and pipe.
- B. Extruded Shapes, Bronze: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- C. Extruded Shapes, Brass: ASTM B 249/B 249M, Alloy UNS No. C36000 (free-cutting brass).
- D. Extruded Shapes, Nickel Silver: ASTM B 249/B 249M, Alloy UNS No. C79600.
- E. Seamless Pipe, Bronze: ASTM B 43, Alloy UNS No. C23000 (red brass, 85 percent copper).
- F. Seamless Tube, Bronze: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- G. Seamless Tube, Brass: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- H. Seamless Tube, Copper: [ASTM B 75](#) (ASTM B 75M), Alloy UNS No. C12200 (phosphorous deoxidized, high residual phosphorous copper).
- I. Castings, Bronze: [**Composition bronze castings complying with ASTM B 62, Alloy UNS No. C83600 (85-5-5-5 or No. 1 composition commercial red brass)**] [or] [**sand castings complying with ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze)**].
- J. Castings, Brass: Sand castings complying with ASTM B 584, Alloy UNS No. C85200 (high-copper yellow brass).
- K. Castings, Copper: ASTM B 824, with a minimum of 99.9 percent copper.
- L. Castings, Nickel Silver: ASTM B 584, Alloy UNS No. C97300 (12 percent leaded nickel silver).
- M. Plate, Sheet, Strip, and Bars; Bronze: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- N. Plate, Sheet, Strip, and Bars; Brass: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- O. Plate, Sheet, Strip, and Bars; Copper: ASTM B 152/B 152M, Alloy UNS No. C11000 (electrolytic tough pitch copper) or Alloy UNS No. C12200 (phosphorous deoxidized, high-residual phosphorous copper).

## 2.6 STAINLESS STEEL

- A. Tubing: ASTM A 554, [**Grade MT 304**] [**Grade MT 316**] [**Grade MT 316L**].
- B. Pipe: ASTM A 312/A 312M, [**Grade TP 304**] [**Grade TP 316**] [**Grade TP 316L**].
- C. Castings: ASTM A 743/A 743M, [**Grade CF 8 or CF 20**] [**Grade CF 8M or CF 3M**].
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, [**Type 304**] [**Type 316**] [**Type 316L**].
- E. Bars and Shapes: ASTM A 276, [**Type 304**] [**Type 316**] [**Type 316L**].
- F. Wire Rope and Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cable Connection (The).
    - b. Carl Stahl DecorCable, Inc.
    - c. Esmet, Inc.
    - d. Feeney Wire Rope & Rigging.
    - e. Hayn Enterprises, LLC.
    - f. Johnson, C. Sherman, Co., Inc.
    - g. Loos & Co., Inc.; Cableware Division.
    - h. Ronstan International Inc.
    - i. Secosouth, Inc.
    - j. **<Insert manufacturer's name>**.
    - k. or approved equal.
  - 2. Wire Rope: [**1-by-19**] [**7-by-7**] [**7-by-19**] **<Insert configuration>** wire rope made from wire complying with ASTM A 492, Type 316.
  - 3. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- G. Expanded Metal: ASTM F 1267, [**Type I (expanded)**] [**Type II (expanded and flattened)**], Class 3 (corrosion-resisting steel), made from stainless-steel sheet complying with ASTM A 666, [**Type 304**] [**Type 316**].
  - 1. Style Designation: [**3/4 number 13**] [**1-1/2 number 10**] **<Insert designation>**.
- H. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316L**], [**0.062 inch** (1.59 mm)] **<Insert thickness>** thick, [**with 1/4-inch** (6.4-mm)] **holes 3/8 inch** (9.5 mm) **o.c. in staggered rows**] **<Insert description>**.
  - 1. Basis-of-Design Product: Provide product with perforations matching **<Insert manufacturer's name; product name or designation>**.
- I. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, [**2-inch** (50-mm)] woven-wire mesh, made from [**0.135-inch** (3.5-mm)] nominal diameter wire complying with ASTM A 580/A 580M, [**Type 304**] [**Type 316**].

## 2.7 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Tubing: **[ASTM A 500 (cold formed)] [or] [ASTM A 513]**.
- C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Expanded Metal: ASTM F 1267, **[Type I (expanded)] [Type II (expanded and flattened)]**, Class 1 (uncoated).
  - 1. Style Designation: **[3/4 number 13] [1-1/2 number 10] <Insert designation>**.
- G. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, **[0.060 inch (1.52 mm)] <Insert thickness>** thick, **[with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows] <Insert description>**.
- H. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, **G90 (Z275)** coating, commercial steel Type B, **[0.064 inch (1.63 mm)] <Insert thickness>** thick, **[with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows] [with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows] <Insert description>**.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
    - b. or approved equal.
- I. Woven-Wire Mesh: Intermediate-crimp, **[diamond] [square]** pattern, **2-inch (50-mm)** woven-wire mesh, made from **0.135-inch (3.5-mm)** nominal diameter wire complying with **ASTM A 510 (ASTM A 510M)**.

## 2.8 GLASS AND GLAZING MATERIALS

- A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.
  - 1. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
  - 2. Thickness for Structural Glass Balusters: **[12.0] [19.0]** mm.

3. Thickness for Structural Glass Balusters: As required by structural loads, but not less than **[12.0] [19.0]** mm.
  4. Thickness for Glass Infill Panels: **[6.0] [10.0]** mm.
  5. Thickness for Glass Infill Panels: As required by structural loads, but not less than **[6.0] [10.0]** mm.
  6. Thickness: As indicated on Drawings.
- B. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than **0.060 inch** (1.52 mm) thick.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
    - b. or approved equal.
  2. Kind: **[LA (laminated annealed)] [LHS (laminated heat strengthened)] [LT (laminated tempered)] [As indicated]**.
  3. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
  4. Interlayer Color: **[Clear] [Blue-green] [Bronze light] [Gray]** **<Insert color>**.
  5. Interlayer Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide]** **<Insert manufacturer's color and pattern designation>**.
  6. Glass Plies for Structural Glass Balusters: **[6.0] [8.0] [10.0]** mm thick, each.
  7. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than **[6.0] [8.0]** mm thick, each.
  8. Glass Plies for Glass Infill Panels: **[3.0] [4.0] [5.0]** mm thick, each.
  9. Glass Plies for Glass Infill Panels: Thickness required by structural loads, but not less than **[3.0] [4.0] [5.0]** mm, each.
- C. Ceramic-Coated Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual" and with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
    - b. or approved equal.
  2. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
  3. Ceramic Coating Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide]** **<Insert manufacturer's color and pattern designation>**.

- D. Plastic Structural Glazing: Uncoated, transparent, monolithic acrylic sheet complying with ASTM D 4802, Category A-1 or A-2 (cell cast or continuous cast), Finish 1 (smooth or polished), and as follows:
1. Color: [**Colorless (clear)**] [**Blue**] [**Blue-green**] [**Bronze**] [**Gray**] [**Green**] [**Match glass**] <Insert color>.
  2. Thickness: [**12.0 mm**] [**Match glass thickness**].
- E. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.
- F. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

## 2.9 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Components: [**Type 304**] [**Type 316**] stainless-steel fasteners.
  2. Copper-Alloy (Bronze) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[ **where concealed; muntz metal (Alloy 280) fasteners where exposed**].
  3. Copper-Alloy (Brass) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[ **where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed**].
  4. Stainless-Steel Components: [**Type 304**] [**Type 316**] stainless-steel fasteners.
  5. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
  6. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
  7. Dissimilar Metals: [**Type 304**] [**Type 316**] stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated[ **and capable of withstanding design loads**].
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless [**otherwise indicated**] [**exposed fasteners are unavoidable**] [**exposed fasteners are the standard fastening method for railings indicated**].



1. Provide **[Phillips] [tamper-resistant] [square or hex socket]** flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: **[Torque-controlled expansion anchors] [or] [chemical anchors]**.
  1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941** (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, **ASTM F 593** (ASTM F 738M), and nuts, **ASTM F 594** (ASTM F 836M).

## 2.10 MISCELLANEOUS MATERIALS

- A. Wood Rails: Clear, straight-grained hardwood rails secured to **[recessed] [exposed]** metal subrail.
  1. Species: **[Ash] [Cherry] [Red oak] [Walnut] [White oak] <Insert species>**.
  2. Finish: **[Manufacturer's standard] [Transparent polyurethane] [Penetrating oil] [Acrylic impregnated]**.
  3. Staining: **[None] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert description or manufacturer's name and product designation>**.
  4. Profile: **[Square, 1-3/4 by 1-3/4 inches (45 by 45 mm) with edges eased to 1/4-inch (6-mm) radius] [Rectangular, 1-3/4 by 5 inches (45 by 127 mm) with edges eased to 1/4-inch (6-mm) radius] [Round, 2-inch (50-mm) diameter] [As indicated] <Insert description>**.
  5. Certified Wood: Fabricate wood rails from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Wood Rails: Hardwood rails complying with Section 064023 "Interior Architectural Woodwork."
- C. Electrical Components: Provide internal, fluorescent light fixtures and electrical components, required as part of illuminated railings, that comply with NFPA 70 and that are listed and labeled by UL.
- D. Plastic Handrail Caps: Thermoplastic rail covering, color as indicated or, if not indicated, as selected by DEN Project Manager from manufacturer's standard colors.
- E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- F. Brazing Rods: For copper-alloy railings, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
- G. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.
- I. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- J. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- K. Shop Primers: Provide primers that comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- L. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- M. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- N. Shop Primer for Galvanized Steel: **[Cementitious galvanized metal primer complying with MPI#26]** **[Vinyl wash primer complying with MPI#80]** **[Water-based galvanized metal primer complying with MPI#134].**
- O. Intermediate Coats and Topcoats: Provide products that comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- P. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- Q. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- R. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

- S. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- T. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: **[At exterior locations] [and] [where indicated]** provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.11 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, **but not less than that required to support structural loads**].
- B. Form ornamental work to required shapes and sizes, with true curves, lines, and angles. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural performance.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature, in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
  - 1. Temperature Change (Range): 100 deg F (55.5 deg C).
- D. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- E. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- G. Form work true to line and level with accurate angles and surfaces.
- H. Provide necessary rebates, lugs, and brackets for assembly of units. Use concealed fasteners wherever possible.

- I. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- J. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- K. Connections: Fabricate railings with **[welded]** **[or]** **[nonwelded]** connections unless otherwise indicated.
- L. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Comply with AWS for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded joints of all welding flux, and dress on all exposed and contact surfaces.
  - 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 3. Obtain fusion without undercut or overlap.
  - 4. Remove flux immediately.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- M. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- N. Brazed Connections: Connect copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.
  - 1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
  - 2. Remove flux immediately.
  - 3. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.
- O. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- P. Form changes in direction as follows:
  - 1. As detailed.
  - 2. **[By bending]** **[or]** **[by inserting prefabricated elbow fittings]**.

3. **[By flush bends] [or] [by inserting prefabricated flush-elbow fittings].**
  4. **[By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated].**
  5. By bending to smallest radius that will not result in distortion of railing member.
- Q. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- R. Finish exposed surfaces to smooth, sharp, well defined lines and arrises.
- S. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- T. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- U. Close exposed ends of hollow railing members with prefabricated end fittings.
- V. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is **1/4 inch** (6 mm) or less.
- W. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- X. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Y. For railing posts set in concrete, provide **[steel] [stainless-steel]** sleeves not less than **6 inches** (150 mm) long with inside dimensions not less than **1/2 inch** (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- Z. For removable railing posts, fabricate slip-fit sockets from **[steel] [stainless-steel]** tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- AA. Expanded-Metal Infill Panels: Fabricate infill panels from **[stainless-steel] [steel]** expanded metal[ **unless otherwise indicated**].

1. Edge panels with U-shaped channels made from same metal as infill; not less than **0.043 inch** (1.1 mm) thick.
  2. Orient expanded metal with long dimension of diamonds [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**].
- BB. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from [**steel**] [**galvanized steel**] [**aluminum**] [**stainless steel**] [**same metal as railings in which they are installed**].
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than **0.043 inch** (1.1 mm) thick.
  2. Orient perforated metal with pattern [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**] [**as indicated on Drawings**].
- CC. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into **1-by-1/2-by-1/8-inch** (25-by-13-by-3-mm) metal channel frames.
1. Make wire mesh and frames from [**aluminum**] [**stainless steel**] [**steel**] [**unless otherwise indicated**].
  2. Orient wire mesh with [**diamonds vertical**] [**wires perpendicular and parallel to top rail**] [**wires horizontal and vertical**].
- DD. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.12 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces
  2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Glass Balusters: Factory-bond glass to aluminum base and top-rail channels in railing manufacturer's plant using glazing cement to comply with manufacturer's written specifications[, **unless field glazing is standard with manufacturer**].
- C. Structural Balusters: Provide [**tempered**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels[ **for both straight and curved sections**].
- D. Structural Balusters: Provide thermoformed, curved, plastic glazing panels for curved sections and [**tempered**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels for straight sections.
- E. Infill Panels: Provide [**tempered**] [**laminated, annealed**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels[ **for both straight and curved sections**].

## 2.13 ILLUMINATED RAILINGS

- A. General: Comply with requirements in this Section for aluminum railings with welded connections.
- B. Illuminated Units: Provide internal illumination using concealed, internally wired, fluorescent-strip fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with those of the power supply provided.
  - 1. Fluorescent Tubes: Provide number of tubes indicated or required by railing length.
  - 2. Diffusers: UV-stabilized acrylic diffusers matching profile of railings.
  - 3. Ballasts: Energy-saving, high power factor, Class P, electromagnetic type; designed for use with high-output lamps, and with automatic-reset thermal protection. Ballasts comply with ANSI C82.1, bear Certified Ballast Manufacturer Certification labels, and are rated for [0 deg F (minus 17 deg C)] [minus 20 deg F (minus 29 deg C)] starting temperature.

## 2.14 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.15 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Mechanical Finish: AA-M3x (Mechanical Finish: as specified); sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.
- C. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.

- D. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
  2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manger's sample**] [**As selected by DEN Project manager from manufacturer's full range**] <Insert color and gloss>.
- F. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- G. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- H. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.

## 2.16 COPPER-ALLOY FINISHES

- A. Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
- B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).



- C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).
  - D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).
  - E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).
  - F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
    - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
  - G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
    - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
  - H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
    - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
  - I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear organic, air drying, as specified below).
    - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
  - J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].
  - K. Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate)[, **with color matching DEN Project Manager's sample**].
- 2.17 STAINLESS-STEEL FINISHES
- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
  - B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. Dull Satin Finish: No. 6.
- E. Satin, Reflective, Directional Polish: No. 7.
- F. Mirrorlike Reflective, Nondirectional Polish: No. 8.
- G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- H. Sputter-Coated Finish: Titanium nitride coating deposited by magnetic sputter-coating process over indicated mechanical finish.

## 2.18 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  1. Hot-dip galvanize[ **exterior**] steel and iron railings, including hardware, after fabrication.
  2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
  3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
  5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  6. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [**SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."**] [**SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."**] [**requirements indicated below:**]
  1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Railings: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with **[universal shop primer] [primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"]** unless **[zinc-rich primer is] [primers specified in Section 099600 "High-Performance Coatings" are]** indicated.
  2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with **[Section 099113 "Exterior Painting."]** **[Section 099600 "High-Performance Coatings."]**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- I. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
  3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils (0.04 mm)**.
  4. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- J. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.

2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 PREPARATION

- A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installation of items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site.

### 3.3 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where necessary for securing ornamental metal items to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws and other connectors as required.
- B. Fit exposed connections together to form tight, hairline joints, or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding and grinding are required for proper shop fitting and jointing of ornamental metal items, restore finishes to eliminate any evidence of such corrective work.
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction
  1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

- D. Corrosion Protection: Coat concealed surfaces of **[aluminum] [and] [copper alloys]** that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as the work progresses, so as to make work weathertight, soundproof or lightproof as required.
- F. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- G. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- H. Restore protective coverings that have been damaged during shipment or installation of the work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.
- I. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- J. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.

### 3.4 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending **2 inches** (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within **6 inches** (150 mm) of post.

### 3.5 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions.

- B. Form or core-drill holes not less than **5 inches** (125 mm) deep and **3/4 inch** (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, **[welded to post after placing anchoring material] [attached to post with set screws]**.
- D. Leave anchorage joint exposed with **[1/8-inch** (3-mm) **buildup, sloped away from post] [anchoring material flush with adjacent surface]**.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
  - 2. For copper-alloy railings, attach posts as indicated using fittings designed and engineered for this purpose.
  - 3. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
  - 4. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.6 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with **[sleeves concealed within] [flanges connected to] [brackets on underside of rails connected to]** railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and **[welded to railing ends] [or] [connected to railing ends using nonwelded connections]**.
- C. Attach handrails to walls with wall brackets**[ except where end flanges are used]**. Provide brackets with **1-1/2-inch** (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 1. Use type of bracket with **[flange tapped for concealed anchorage to threaded hanger bolt] [predrilled hole for exposed bolt anchorage]**.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets**[ and railing end flanges]** to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into[ **fire-retardant-treated**] wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

### 3.7 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
1. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass panels[ **if glass was bonded to base and top rail channels in factory**].
  2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement[ **unless glass was bonded to base and top rail channels in factory**].
    - a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
  3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
  4. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.
- B. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

### 3.8 INSTALLING PLASTIC HANDRAIL CAPS

- A. Apply plastic handrail caps to top rails and handrails, where indicated, complying with manufacturer's written instructions for cutting, mounting, forming, welding, cleaning, applying end caps, and finishing.
- B. Minimize number of joints in plastic caps by installing in lengths as long as possible. Allow for shortening of plastic cap caused by welding and splicing process; butt ends together to produce hairline joint.

1. Continuously weld, splice, miter, and end-cap joints using cap manufacturer's electric welding iron designed for this purpose. Remove welding flash while material is still soft.
2. Weld only prongs on underside of plastic cap at splice, miter, and end-cap joints. After cutting plastic cap, dress ends with file to produce a hairline fit between abutting sections. After mounting cap, polish top surface with cap manufacturer's solvent designed for this purpose until joint becomes almost invisible.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made **[by Owner] [from the testing and inspecting allowance, as authorized by Change Orders]**.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to DEN Project Manager and will comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.10 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- C. Clean and polish **[glass] [and] [plastic glazing]** as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.
- D. Clean **[wood rails] [and] [plastic handrail caps]** by wiping with a damp cloth and then wiping dry.
- E. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.



1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.
  - F. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
  - G. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- 3.11 PROTECTION
- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
  - B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 057300

## SECTION 057500 - DECORATIVE FORMED METAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Beam wraps.
2. Closures and trim.
3. Column covers and bases.
4. Chair rails.
5. Corner guards.
6. Decorative-metal-clad, hollow-metal doors and frames.
7. Diamond plate wainscot.
8. Elevator [**cab**] [**and**] [**entrance**] finishes.
9. Escalator enclosures.
10. Filler panels [**at demountable partitions**] [**between dissimilar construction**].
11. Gate Portal/Check-in backwall.
12. Heating-cooling unit enclosures.
13. Lighting coves.
14. Mechanical duct enclosures at Holdrooms.
15. Metal base.
16. Mullion cladding.
17. Pipe system covers.
18. Pockets for window treatment.
19. Sign Shelf at Subcore.
20. Subcore accent wall.
21. Support system for ceiling-hung Way Finding Signage.
22. Support system for Flight Information Display System (FIDS).
23. Miscellaneous items not specified in other Sections.
24. Window stools.
25. Exterior fins.
26. Exterior formed-metal-shaped panels.
27. Exterior sunshades.
28. Exterior trellises.
29. Exterior window covers.
30. Metal shapes as part of roof construction.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.
  2. Section 057000 "Decorative Metal" for items made primarily from plate, bars, extrusions, tubes, castings, and other forms of metal, but which may include sheet metal components.
  3. Section 057300 "Decorative Metal Railings."
  4. Section 076100 "Sheet Metal Roofing" for items made of formed metal for roofing.
  5. Section 076200 "Sheet Metal Flashing and Trim" for items made of formed metal for flashings and trim.
  6. Section 077100 "Roof Specialties" for items made of formed metal for parapets and copings.
  7. Section 081113 "Hollow Metal Doors and Frames" for flush hollow-metal doors and frames receiving decorative metal cladding.
  8. Section 089000 "Louvers and Vents" for louvers made of formed metal.
  9. **[Section 142100 "Electric Traction Elevators"] [and] [Section 142400 "Hydraulic Elevators"]** for elevator cab and entrance components made from sheet metal.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design exterior decorative formed metal items, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Decorative formed metal items, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:
1. Wind Loads on Exterior Items: **[As indicated on Drawings] [20 lbf/sq. ft. (957 Pa)] [30 lbf/sq. ft. (1436 Pa)] <Insert specific loads>**.
  2. Live Loads on Heating-Cooling Unit Enclosures: **100 lbf/sq. ft. (4.8 kN/sq. m)** or a concentrated load of **300 lbf (1.3 kN)** on an area of **4 sq. in. (26 sq. cm)**, whichever produces the greater stress.
- C. Seismic Performance: Exterior decorative formed metal items, including anchors and connections, shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
1. Component Importance Factor is 1.0.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: **120 deg F** (67 deg C), ambient; **180 deg F** (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [paints and coatings]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
  - a. Include setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as unit of Work of other sections.

- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].

- E. Samples for Verification: For each type of exposed finish required, prepared on **6-inch-** (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1. Include 12 inch long samples of linear shapes.
2. **<Insert other samples>**.
3. Include entire column section for each type
4. **<Insert other samples>**.

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

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.
- B. Qualification Data: For qualified [**Installer**] [**fabricator**] [**organic-coating applicator**] [**anodic finisher**] [**powder-coating applicator**] [**and**] [**professional engineer**].
- C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Warranty: Submit copy of manufacturer's product warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For [**mirrorlike stainless-steel finish**] [**and**] [**statuary conversion coating copper-alloy finish**] to include in maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

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

1.8 MAINTENANCE MATERIAL

- A. Provide minimum two (2) gallons of each type of paint, primer or finish coating. Store in location as directed by DEN Project Manager.
  - 1. Instruct Owner's personnel in appropriate paint touch-up techniques.

1.9 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Arrange for installation of ornamental work specified in this section by same firm that manufactured products, to highest degree possible.
- C. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

- D. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- F. Installer Qualifications: Fabricator of products.
- G. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.3, "Structural Welding Code - Sheet Steel."
  4. AWS D1.6, "Structural Welding Code - Stainless Steel."
- H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for the following types of decorative formed metal:
    - a. **<Insert, in separate subparagraphs, description of each decorative metal type including mockup size>.**
  2. Where installed products are indicated to comply with certain design loadings including glass support, include structural computations, material properties, and other information needed for structural analysis that has been prepared by, or under the supervision of, a qualified professional engineer.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>.**
- J. Paint testing: Provide certification that factory applied paint complies with specified requirements.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
  - B. Store products on elevated platforms in a dry location.

## 1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Coordinate fabrication schedule with construction progress to avoid delay of Work.

## 1.12 COORDINATION

- A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

## 1.13 WARRANTY

- A. Warranty: Installer to warrant all elements of fabrication, including material, anchors, and finish. Provide minimum three (3) year **<Insert number>** system warranty and five (5) year **<Insert number>** finish warranty.

## 1.14 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 SHEET METAL

- A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- C. Aluminum Sheet: Flat sheet complying with [ASTM B 209](#) (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H32.

- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating, either commercial steel or forming steel.
- E. Steel Sheet: **[Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed] [or] [electrolytic zinc-coated, ASTM A 879/A 879M, with steel sheet substrate complying with ASTM A 1008/A 1008M, commercial steel, exposed].**
- F. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, **[Type 304] [Type 316]**, stretcher-leveled standard of flatness.
- G. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper).
- H. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- I. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- J. Titanium Sheet: ASTM B 265, Grade 1.

## 2.2 MISCELLANEOUS MATERIALS

- A. Gaskets: As required to seal joints in decorative formed metal and remain **[airtight] [weathertight]**; as recommended in writing by decorative formed metal manufacturer.
  - 1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
  - 2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Sealants, Exterior: ASTM C 920; elastomeric **[silicone] [polyurethane] [or] [polysulfide]** sealant; of type, grade, class, and use classifications required to seal joints in decorative formed metal and remain weathertight; and as recommended in writing by decorative formed metal manufacturer.
- C. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.
  - 1. Sealants shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.
  - 1. Use filler metals that will match the color of metal being joined and will not cause



discoloration.

- E. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless **[otherwise indicated] [exposed fasteners are unavoidable or are the standard fastening method]**.
  2. Provide **[Phillips] [tamper-resistant] [square or hex socket]** flat-head machine screws for exposed fasteners unless otherwise indicated.
- F. Structural Anchors: For applications indicated to comply with certain design loads, provide **[chemical] [or] [torque-controlled expansion]** anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- G. Nonstructural Anchors: For applications not indicated to comply with design loads, provide **[powder-actuated fasteners] [metal expansion sleeve anchors] [or] [metal-impact expansion anchors]** of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.
- H. Anchor Materials:
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941** (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, **ASTM F 593** (ASTM F 738M), and nuts, **ASTM F 594** (ASTM F 836M).
- I. Sound-Deadening Materials:
1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
  2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.
- J. Backing Materials: Provided or recommended by decorative formed metal manufacturer.
- K. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.
1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Multipurpose Construction Adhesive: VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  4. Special-Purpose Contact Adhesive: (Contact adhesive used to bond melamine-covered board, metal, unsupported vinyl, ultrahigh molecular weight polyethylene, and rubber or wood veneer, 1/16 inch thick or less, to any surface): 250 g/L.
  5. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- L. Isolation Coating: Manufacturer's standard [**alkali-resistant coating**] [**bituminous paint**] [**epoxy coating**].
1. Coating shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 PAINTS AND COATINGS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.
- E. Shop Primers: Comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- F. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: [**Cementitious galvanized metal primer complying with MPI#26**] [**Vinyl wash primer complying with MPI#80**] [**Water-based galvanized metal primer complying with MPI#134**].
- I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature, in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
  - 1. Temperature Change (Range): 100 deg F, (55.5 deg C).
- D. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a **1/2-inch** (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately **1/32 inch** (1 mm) and support with concealed stiffeners.
- E. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
  - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
  - 2. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
  - 3. Provide adequate separation of dissimilar metals subject to galvanic corrosion.
- F. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.
- G. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.
- H. Where welding or brazing is indicated, weld, or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
  - 1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

## 2.5 BEAM WRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hi-Tech Metals, Inc.
  2. Industrial Louvers Inc.
  3. Metal Sales & Service, Inc.; Metalwerks Division.
  4. MM Systems Corporation.
  5. Southwest Metalsmiths.
  6. **<Insert manufacturer's name>**.
  7. or approved equal.
- B. Form beam wraps from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
  2. Steel Sheet: [**0.060 inch (1.52 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
  3. Stainless-Steel Sheet: [**0.050 inch (1.27 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].
- C. Fabricate with calk stop angle to retain backer rod and sealant.

## 2.6 CLOSURES AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fry Reglet Corporation.
  2. Pittcon Industries.
  3. **<Insert manufacturer's name>**.
  4. or approved equal.
- B. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction[, **with weathertight joints at exterior installations**].
1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.

- a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
  2. Galvanized-Steel Sheet: [**0.052 inch (1.32 mm)**] [**Thickness required to comply with performance requirements**] <Insert thickness>.
    - a. Finish: [**Factory primed**] [**Baked enamel**] [**Siliconized polyester**] [**High-performance organic coating**] [**Powder coat**].
  3. Steel Sheet: [**0.048 inch (1.21 mm)**] [**Thickness required to comply with performance requirements**] <Insert thickness>.
    - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
  4. Closures and trim may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view and not exposed to weather.
- C. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.
- D. Drill and tap holes needed for securing closures and trim to other surfaces.
- E. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.
- F. Miter or cope trim members at corners and reinforce with bent metal splice plates to form tight joints.

## 2.7 COLUMN COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ATAS International, Inc.
  2. Ceilings Plus.
  3. Construction Services, Inc.
  4. Couturier Iron Craft, Inc.
  5. Firestone Metal Products, LLC; Una-Clad.
  6. Fry Reglet Corporation.
  7. Hi-Tech Metals, Inc.
  8. Industrial Louvers Inc.
  9. Kanalco Ltd.
  10. Leed Himmel Industries, Inc.
  11. Metal Sales & Service, Inc.; Metalwerks Division.
  12. MM Systems Corporation.
  13. Nelson Industrial Inc.
  14. Pittcon Industries.
  15. Protean Construction Products, Inc.

16. Southwest Metalsmiths.
  17. **<Insert manufacturer's name>**.
  18. or approved equal.
- B. Spackled-Seam Type: Form column covers from **0.125-inch** (3.2-mm) aluminum, rolled to radii indicated. Taper edges of adjoining pieces of column covers, for taping and spackling, to **0.094-inch** (2.4-mm) thickness in approximately **1 inch** (25 mm) of width. Punch tapered edges for gypsum board screws at **1/2 inch** (12 mm) o.c., and mill grooves in tapered edge to improve bond with joint compound.
1. Support Framing: At vertical joints, provide **1-1/2-by-3-5/8-inch** (38-by-89-mm) steel channel support posts formed from **0.040-inch** (1.0-mm) galvanized steel.
  2. Joint Treatment Materials: Provide joint treatment compounds and reinforcing tape complying with requirements in Section 092900 "Gypsum Board."
- C. Snap-Together Type: Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that will engage continuous mounting clips.
1. Aluminum Sheet: [**0.063 inch** (1.60 mm)] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
  2. Steel Sheet: [**0.060 inch** (1.52 mm)] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
  3. Stainless-Steel Sheet: [**0.109 inch** (2,78 mm)] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].
  4. Bronze Sheet: [**0.051 inch** (1.29 mm)] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Statuary conversion coating over satin finish**].
  5. Brass Sheet: [**0.051 inch** (1.29 mm)] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
    - a. Finish: [**Buffed**] [**Hand-rubbed**] finish, lacquered.
    - b. Delete first subparagraph below if not acceptable or not applicable.
  6. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
  7. Form returns at vertical joints to provide hairline V-joints.

8. Form returns at vertical joints to provide [**1/2-inch- (12-mm-)**] [**3/4-inch- (18-mm-)**] wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals [**1/2 inch (12 mm) deep**] [**flush**].
9. Form returns at vertical joints to accommodate backer rod and sealant.
10. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
11. Fabricate column covers without horizontal joints.
12. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
13. Fabricate column covers with [**1/2-inch- (12-mm-) wide**] reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
14. Fabricate [**base**] [**ceiling**] ring to [**match**] [**contrast with**] column covers.
15. Fabricate with calk stop/stiffener ring.
16. Apply manufacturer's recommended sound-deadening [**insulation**] [**mastic**] [**mastic and insulation**] to backs of column covers.

## 2.8 STAINLESS STEEL CORNER GUARDS

- A. Surface-mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90 degree or 135 degree turn to match wall condition

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
  - a. Construction Specialties, Inc.
  - b. IPC Door and Wall Protection Systems; Division of InPro Corp.
  - c. Pawling Corp.
  - d. **<Insert manufacturer's name>**
  - e. or approved equal.
2. Material: Stainless steel, Type 304.
  - a. Thickness: Minimum 0.0625 in. (1.6 mm).
  - b. Finish: Directional satin, No. 4
3. Wing Size: **<Insert number> <Refer to Drawings>**.
4. Corner Radius: 1/8 inch (3 mm).
5. Mounting: Flat-head, stainless steel, countersunk screws through factory-drilled mounting holes.

## 2.9 STAINLESS STEEL CHAIR RAILS

- A. Form custom chair rails from metal of type and thickness indicated below. Coordinate size of chair rails, location, and method of attachment to adjoining construction with

details on Drawings.

1. Stainless Steel Sheet Thickness: **<Insert number> <Refer to Drawings>**.
  - a. Finish: Refer to Drawings.
  - b. Attachment: Refer to Drawings.
  - c. Form and pattern: Refer to Drawings.

2.10 STAINLESS STEEL SUPPORT FOR FLIGHT INFORMATION DISPLAY SYSTEMS (FIDS)

- A. Monitor Brackets and cable/connector covers shall be as designed and manufactured by Display Devices, 5880 Sheridan Blvd., Arvada, CO.
- B. Stainless steel cable and cable fittings shall be Ronstan Stainless Steel 316g, spiral strand, 1 x 19 cable, WR6119 with Ronstan Stainless Steel threaded swage ends, RF 1511-3222, with nuts and washers.
  1. Hardware: Stainless steel, as described on Drawings. Use security screws at panel fasteners.
  2. Finish: AISI No. 4.

2.11 DIAMOND PLATE, CHROME-PLATED STEEL WAINSCOT

- A. **<Insert requirements or refer to Drawings>**.

2.12 DUCT ENCLOSURES AT HOLD ROOMS

- A. **<Insert requirements or refer to Drawings>**.

2.13 SIGN SHELF AT SUBCORE

- A. **<Insert requirements or refer to Drawings>**.

2.14 SUBCORE ACCENT WALL

- A. **<Insert requirements or refer to Drawings>**.

2.15 SUPPORT SYSTEM FOR WAY FINDING SIGNAGE

- A. **<Insert requirements or refer to drawings>**.



## 2.16 DECORATIVE-METAL-CLAD DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dawson Metal Co., Inc.
  2. InKan Limited.
  3. Krieger Specialty Products Company.
  4. **<Insert manufacturer's name>**.
  5. or approved equal.
- B. Laminate metal sheets, of type and thickness indicated below, to faces of **[hollow-metal doors and frames]** **[and]** **[elevator entrances]** where indicated:
1. Bronze Sheet: **[0.040 inch (1.02 mm)] <Insert thickness>**.
    - a. Finish: **[Buffed finish, lacquered]** **[Hand-rubbed finish, lacquered]** **[Statuary conversion coating over satin finish, lacquered]**.
  2. Brass Sheet: **[0.040 inch (1.02 mm)] <Insert thickness>**.
    - a. Finish: **[Buffed]** **[Hand-rubbed]** finish lacquered.
  3. Stainless-Steel Sheet: **[0.038 inch (0.95 mm)] <Insert thickness>**.
    - a. Finish: **[No. 2B]** **[No. 4]** **[No. 6]** **[No. 7]** **[No. 8]**.
  4. Titanium Sheet: **[0.025 inch (0.64 mm)] <Insert thickness>**.
    - a. Finish: **[Dull]** **[Bright]** matte.

## 2.17 ESCALATOR ENCLOSURES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hi-Tech Metals, Inc.
  2. KPK Stainless.
  3. Metal Sales & Service, Inc.; Metalwerks Division.
  4. Southwest Metalsmiths.
  5. **<Insert manufacturer's name>**.
  6. or approved equal.
- B. Form escalator enclosures from metal of type and thickness indicated below. Coordinate size of enclosures, location of cutouts, and method of attachment to adjoining construction.
1. Stainless-Steel Sheet: **[0.062 inch (1.59 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.

- a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.
2. Bronze Sheet: **[0.081 inch (2.05 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
  - a. Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish]**.

## 2.18 FILLER PANELS

- A. Form filler panels for closing ends of partition systems and for other applications indicated. Form from two sheets of metal of type and thickness indicated below, separated by channels formed from the same material, producing a panel of same thickness as **[partitions] [mullions]** unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.
  1. Galvanized-Steel Sheet: **[0.064 inch (1.63 mm)] <Insert thickness>**.
    - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  2. Steel Sheet: **[0.060 inch (1.52 mm)] <Insert thickness>**.
    - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
  3. Filler panels may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
- B. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces.
- C. Adhesively attach gaskets to filler panel edges where they abut mullions or glazing. Use **1-inch-** (25-mm-) square material, unless otherwise indicated, set approximately **1/4 inch** (6 mm) into channeled edge of filler panel.
- D. Attach gaskets to all edges of panels that abut adjacent surfaces to form a continuous seal. Use compressible gaskets or mastic sealing tape, applied to center of panel edges to be concealed from view, unless otherwise indicated.
- E. Do not mechanically fasten filler panels to mullions.

## 2.19 HEATING-COOLING UNIT ENCLOSURES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Airflex Industries, Inc.
  2. Architectural Grille; Div. of Giumenta Corp.
  3. Arsko Manufacturing Company.

4. Kees, Inc.
  5. Precision Metal Fabricators, Inc.
  6. **<Insert manufacturer's name>**.
  7. or approved equal.
- B. Fabricate heating-cooling unit enclosures from metal of type and thickness indicated below:
1. Galvanized-Steel Sheet:
    - a. Framing: **[0.108 inch (2.74 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
    - b. Sills and Stools: **[0.079 inch (2.01 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
    - c. Front Panels and Bases: **[0.064 inch (1.63 mm)] <Insert thickness>**.
    - d. Concealed Panels and Trim: **[0.040 inch (1.02 mm)] <Insert thickness>**.
    - e. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  2. Steel Sheet:
    - a. Framing: **[0.105 inch (2.66 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
    - b. Sills and Stools: **[0.075 inch (1.90 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
    - c. Front Panels and Bases: **[0.060 inch (1.52 mm)] <Insert thickness>**.
    - d. Concealed Panels and Trim: **[0.036 inch (0.91 mm)] <Insert thickness>**.
    - e. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
- C. Weld seams and connections unless otherwise indicated or unless other methods are necessary for access to heating and cooling equipment.
- D. Incorporate stiffeners or laminated backing using noncombustible materials as needed for strength and rigidity.
1. Fill space between stiffeners with sound-deadening insulation attached to face sheet with insulation adhesive unless otherwise indicated.
  2. Coat concealed faces of metal panels more than **6 inches (150 mm)** wide with a heavy coating of sound-deadening mastic applied at the minimum rate of **20 sq. ft./gal. (0.5 sq. m/L)**.
- E. Provide louvers and grilles of size, type, and materials indicated.
1. For removable grilles, use modular units with recessed openings formed into surfaces of enclosures and without blank filler panels between grilles, so face panels and stools are continuous. Fabricate removable grilles and openings to precise tolerances to produce well-fitted assemblies free of warp or rattle, with grilles supported continuously along parallel edges and with tops flush with top of enclosure.

- F. Incorporate removable tops and fronts where indicated or needed for access to heating-cooling units and to piping, ductwork, controls, and electrical service, with panels and openings as follows:
1. Fabricate with a fitting tolerance of not less than **1/32 inch** (0.8 mm) and not more than **1/16 inch** (1.6 mm) at each edge, with face of panels flush with adjoining fixed surfaces of enclosure.
  2. Form panels for easy removal without interfering with adjoining construction or furniture. Hold panels in place with concealed clips and hardware that prevent warp and rattle.
- G. Incorporate hinged access panels in enclosures for access to heating-cooling unit controls, as either separate elements or integrated with grille openings, as indicated or needed.
- H. Coordinate construction, configuration, and dimensions of enclosures with those of heating-cooling units. Provide support for heating-cooling units and controls where indicated. Provide blind knockouts and supports for piping, ductwork, control lines, electrical conduit, and wiring where indicated or needed.
- I. Locate fixed surfaces of enclosure to coincide precisely with window mullions and partition system terminations. Provide closures at ends of units, at recessed openings in base of units, and at other locations where needed to conceal unfinished wall or floor surfaces, piping, conduit, ductwork, or heating-cooling units.
1. Provide built-in partitions (bulkheads) within enclosures between heating-cooling units, located to coincide with mullions and partition system terminations. Seal partitions to faces of enclosures with compressible gaskets or mastic sealing tape, and cover both sides of partitions with sound-deadening insulation attached to partitions with insulation adhesive.

## 2.20 LIGHTING COVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fry Reglet Corporation.
  2. Gordon, Inc.; Gordon Interior Specialties Division.
  3. Hi-Tech Metals, Inc.
  4. MM Systems Corporation.
  5. Pittcon Industries.
  6. **<Insert manufacturer's name>**.
  7. or approved equal.
- B. Form lighting coves from metal of type and thickness indicated below. Coordinate size of coves, location of cutouts for electrical wiring, and method of attachment to adjoining construction.
1. Aluminum Sheet: [**0.063 inch** (1.60 mm)] **<Insert thickness>**.

- a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
2. Galvanized-Steel Sheet: [**0.052 inch (1.32 mm)**] <Insert thickness>.
  - a. Finish: [**Factory primed**] [**Baked enamel**] [**Siliconized polyester**] [**High-performance organic coating**] [**Powder coat**].
3. Steel Sheet: [**0.048 inch (1.21 mm)**] <Insert thickness>.
  - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
4. Fabricate light covers with [**hairline butt joints**] [**tapered edges for taping and spackling**].
5. Provide [**mitered corners, factory welded with backplates**] [**factory endcaps**].
6. Lighting covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.

## 2.21 METAL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Fry Reglet Corporation.
  2. Pittcon Industries.
  3. <Insert manufacturer's name>.
  4. or approved equal.
- B. Form metal base from metal of type and thickness indicated below:
  1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] <Insert thickness>.
    - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
  2. Stainless-Steel Sheet: [**0.050 inch (1.27 mm)**] <Insert thickness>.
    - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].

## 2.22 MULLION CLADDING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hi-Tech Metals, Inc.
  2. International Metal Worksw.
  3. KPK Stainless.
  4. Metal Sales & Service, Inc.; Metalwerks Division.
  5. Southwest Metalsmiths.

6. **<Insert manufacturer's name>**.
  7. or approved equal.
- B. Form mullion cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
1. Aluminum Sheet: **[0.063 inch (1.60 mm)] <Insert thickness>**.
    - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
  2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] <Insert thickness>**.
    - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  3. Stainless-Steel Sheet: **[0.050 inch (1.27 mm)] <Insert thickness>**.
    - a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.

## 2.23 PIPE SYSTEM COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ArSCO Manufacturing Company.
  2. Grice Engineering, Inc.
  3. **<Insert manufacturer's name>**.
  4. or approved equal.
- B. Form pipe system covers from metal of type and thickness indicated below. Coordinate size of covers, location of cutouts for piping, and method of attachment to adjoining construction.
1. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] <Insert thickness>**.
    - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  2. Steel Sheet: **[0.048 inch (1.21 mm)] <Insert thickness>**.
    - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.

## 2.24 POCKETS FOR WINDOW TREATMENT

- A. Form pockets from metal of type and thickness indicated below, with end closures. Coordinate dimensions and attachment methods with window treatment equipment, window frames, ceiling suspension system, and other related construction to produce a coordinated, closely fitting assembly.

1. Aluminum Sheet: **[0.063 inch (1.60 mm)]** <Insert thickness>.
    - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
  2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)]**.
    - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  3. Steel Sheet: **[0.048 inch (1.21 mm)]** <Insert thickness>.
    - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
  4. Pockets for window treatment may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
- B. Reinforce pockets for attaching window treatment equipment and hardware, or increase metal thickness.
- C. Divide continuous pockets with built-in partitions located to separate adjoining drapery and blind units, to coincide with window mullions, and to receive filler panels at ends of partitions.

## 2.25 WINDOW STOOLS

- A. Form window stools from metal of type and thickness indicated below, with end closures:
1. Aluminum Sheet: **[0.063 inch (1.60 mm)]** <Insert thickness>.
    - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
  2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)]** <Insert thickness>.
    - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
  3. Stainless-Steel Sheet: **[0.050 inch (1.27 mm)] [1.3 mm]** <Insert thickness>.
    - a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.
  4. Bronze Sheet: **[0.051 inch (1.29 mm)]** <Insert thickness>.
    - a. Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish]**.
- B. Weld seams at end closures.

- C. Braze seams at end closures.
- D. Apply sound-deadening [**insulation**] [**mastic**] to underside of window stools.

## 2.26 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- E. Finish [**items indicated on Drawings**] <Insert product> after assembly.
- F. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.27 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
  - 1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
  - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from**



manufacturer's full range] **<Insert color and gloss>**.

- E. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] **<Insert color and gloss>**.
- F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] **<Insert color and gloss>**.
- G. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] **<Insert color and gloss>**.

## 2.28 GALVANIZED-STEEL SHEET FINISHES

- A. Preparing Galvanized Items for Factory Priming: Thoroughly clean galvanized decorative formed metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- B. Preparing Galvanized Items for Factory Finishing: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Repairing Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A 780.
- D. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- E. Factory-Painted Finish: Comply with **[Section 099113 "Exterior Painting. "] [Section 099600 "High-Performance Coatings. "]**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project**

**Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

- F. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil** (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- G. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- H. Siliconized-Polyester Coating: Immediately after cleaning and pretreating, apply manufacturer's standard epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- I. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- J. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

## 2.29 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
- B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- D. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
  - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- E. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
  - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

## 2.30 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- D. Directional Satin Finish: No. 4.
- E. Dull Satin Finish: No. 6.
- F. Satin, Reflective, Directional Polish: No. 7.

- G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.
- H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## 2.31 COPPER-ALLOY FINISHES

- A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
- B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).
- C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).
- D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).
- E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).
- F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
  - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
  - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
  - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear organic, air drying, as specified below).
  - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish:

directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].

- K. Statuary Conversion Coating over Satin Finish, Lacquered: M31-C55-O6x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air drying, as specified below) [, **with color matching DEN Project Manager's sample**]:
1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).

## 2.32 TITANIUM FINISHES

- A. General: Fabricate items from finished titanium sheet, taking care not to damage finish during fabrication. Protect finish as needed during fabrication by applying a strippable, temporary protective covering.
- B. Dull Matte Finish: Pickled and annealed.
- C. Bright Matte Finish: Vacuum annealed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Restore protective coverings that have been damaged during shipment or installation of the work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.
1. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- B. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
  - C. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
  - D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
  - E. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior decorative formed metal items weatherproof.
  - F. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.
  - G. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
  - H. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 081113 "Hollow Metal Doors and Frames."
  - I. Apply joint treatment at joints of spackled-seam-type metal column covers. Comply with requirements in Section 092900 "Gypsum Board."
  - J. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.
    1. Do not field weld without prior approval from DEN Project Manager, with DEN approved safety precautions in place.
- 3.3 ADJUSTING AND CLEANING
- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
  - B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
  - C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as

used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.

D. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting" Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]

E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

### 3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

## PART 4 - MEASUREMENT

A. METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

A. METHOD OF PAYMENT

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

END OF SECTION 057500

## SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.
- C. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation, including stud head expansion.
- D. Samples: Submit one foot long sample of each type of stud, head and runner channels, expansion head track, fasteners, anchors.
- E. Certificate from manufacturer stating that all materials are per contract requirements and providing proof of minimum five (5) years experience manufacturing products required of similar size.
- F. Certificate from installer evidencing a minimum five (5) years successful experience installing this type of work on projects.
- G. Mock-up: Provide a mock-up of components of this section. Coordinate all work.
- H. LEED Submittals:
  - 1. Product Data for Credit MR 4: For products having recycled content,



- documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
    - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
  4. Laboratory Test Reports for Credit EQ 4: For gypsum board shaft wall systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 1.4 INFORMATIONAL SUBMITTALS
- A. Evaluation Reports: For [**shaft wall assemblies**] [**firestop tracks**], from ICC-ES.
- 1.5 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 QUALITY ASSURANCE
- A. Fire Rated Assemblies: Where framing units are components of assemblies indicated for a fire resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities having jurisdiction.
  - B. Pre-installation conference: Prior to installation of work, meet at the project site or other mutually agreed location with installer, contractor, DEN Project Manager and other job related contractors.

- C. Warranty: Installer to warrant system for two (2) years, including framing and finish.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## D. CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Low-Emitting Materials: Gypsum shaft wall assemblies shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES <Insert drawing designation>
- A. Fire-Resistance Rating: [As indicated] [1 hour] [2 hours] [3 hours] [4 hours] <Insert rating>.
  - B. STC Rating: [As indicated] [51, minimum] <Insert rating>.
  - C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
    - 1. Depth: [As indicated] [2-1/2 inches (64 mm)] [4 inches (102 mm)] [6 inches (152 mm)].
    - 2. Minimum Base-Metal Thickness: [As indicated] [0.033 inch (0.84 mm)] <Insert value>.
  - D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least [2 inches (51 mm)] <Insert dimension> long and matching studs in depth.
    - 1. Minimum Base-Metal Thickness: [As indicated] [Matching steel studs] [0.021 inch (0.53 mm)] [0.033 inch (0.84 mm)] <Insert value>.
  - E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
  - F. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than [0.033 inch (0.84 mm)] <Insert dimension> thick.
  - G. Room-Side Finish: [As indicated] [Gypsum board] [Gypsum veneer plaster] [Cementitious backer units] <Insert finish>.
  - H. Shaft-Side Finish: [As indicated] [Gypsum shaftliner board, Type X] [Gypsum shaftliner board, moisture- and mold-resistant Type X] [As indicated by fire-resistance-rated assembly design designation] <Insert finish>.
  - I. Insulation: Sound attenuation blankets.
- 2.3 PANEL PRODUCTS
- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
  - B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
  - C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

- D. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- E. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Gypsum; Shaft Liner.
    - b. CertainTeed Corp.; ProRoc Shaftliner.
    - c. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
    - d. Lafarge North America, Inc.; Firecheck Type X Shaftliner.
    - e. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
    - f. PABCO Gypsum; Pabcore Shaftliner Type X.
    - g. Temple-Inland Inc.; Fire-Rated SilentGuard Gypsum Shaftliner System.
    - h. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
    - i. **<Insert manufacturer>**
    - j. or approved equal.
  2. Thickness: 1 inch (25.4 mm).
  3. Long Edges: Double bevel.
- F. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Shaftliner.
    - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
    - c. Lafarge North America, Inc.; Firecheck Moldcheck Type X Shaftliner.
    - d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
    - e. PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
    - f. Temple-Inland Inc.; Fire-Rated SilentGuard TS Mold-Resistant Gypsum Shaftliner System.
    - g. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
    - h. **<Insert manufacturer>**
    - i. or approved equal.
  2. Thickness: 1 inch (25.4 mm).
  3. Long Edges: Double bevel.
  4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- G. Gypsum Board: As specified in Section 092900 "Gypsum Board."
- H. Gypsum Base for Gypsum Veneer Plaster: As specified in Section 092613 "Gypsum Veneer Plastering."

- I. Cementitious Backer Units: As specified in [**Section 092900 "Gypsum Board."**] [**Section 093000 "Tiling."**]

## 2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <Insert number> percent.
- B. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  1. Protective Coating: [**Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120)**] [**ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized**] [**ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized**] unless otherwise indicated.
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak System[ **attached to studs with Fire Trak Posi Klip**].
    - b. Grace Construction Products; FlameSafe FlowTrak System.
    - c. Metal-Lite, Inc.; The System.
    - d. Steel Network Inc. (The); [**VertiClip SLD**] [**VertiTrack VTD**] Series.
    - e. <Insert manufacturer>
    - f. or approved equal.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in [**Section 092900 "Gypsum Board"**] [**Section 092613 "Gypsum Veneer Plastering"**] that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability

- to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
2. Powder-Actuated Anchors: Powder-actuated fasteners are not permitted and shall not be used.
- E. Sound Attenuation Blankets: As specified in [**Section 092900 "Gypsum Board."**] [**Section 092613 "Gypsum Veneer Plastering."**]
- F. Acoustical Sealant: As specified in [**Section 092900 "Gypsum Board."**] [**Section 092613 "Gypsum Veneer Plastering."**]

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway doorframes, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

#### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted doorstops, and similar items that cannot be supported directly by shaft wall assembly framing.
1. Elevator Hoistway: At elevator hoistway-entrance doorframes, provide jamb struts on each side of doorframe.
  2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with [0.033-inch (0.84-mm)] **<Insert dimension>** minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints [**at locations indicated on Drawings**] [**according to ASTM C 840 and in specific locations approved by DEN Project Manager**] while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Cant Panels: At projections into shaft [**exceeding 4 inches (102 mm)**] [**where indicated**], install 1/2- or 5/8-inch- (13- or 16-mm-) thick gypsum board cants covering tops of projections.
1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
  2. Where steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 092116.23



## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

- B. Related Requirements:

- 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
  - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for fire-resistance-rated vertical shaft and horizontal enclosures, including metal framing.

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

#### 1.3 ACTION SUBMITTALS

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

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

- B. LEED Submittals:

- 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

#### 1.4 INFORMATION SUBMITTALS

- A. Evaluation Reports: For [**dimpled steel studs and runners**] [**firestop tracks**], from

ICC-ES.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Mockups: Reference Section 092900 for mockups of gypsum board assemblies.
- B. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, whenever possible, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack materials to prevent damage.

1.8 CONSTRUCTION WASTE MANAGEMENT

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

**PART 2 - PRODUCTS**

2.1 DESCRIPTION

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** <Insert number> percent.

## 2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** <Insert number> percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  2. Protective Coating: **[ASTM A 653/A 653M, G40 (Z120)] [ASTM A 653/A 653M, G60 (Z180)] [Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120)]**, hot-dip galvanized, unless otherwise indicated.
- C. Studs and Runners: ASTM C 645. **[ Use either steel studs and runners or dimpled steel studs and runners.]**
1. Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: **[As indicated on Drawings]** **[0.027 inch (0.68 mm)] [0.033 inch (0.84 mm)]**.
    - b. Depth: **[As indicated on Drawings]** **[3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)]**.
  2. Dimpled Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: **[As indicated on Drawings]** **[0.025 inch (0.64 mm)]**.
    - b. Depth: **[As indicated on Drawings]** **[3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)]**.
- D. Slip-Type Head Joints: Where indicated, provide **[ one of]** the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with **2-inch-** (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within **12 inches (305 mm)** of the top of studs to provide lateral bracing.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with **2-inch-** (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
  - 2) MBA Building Supplies; [**FlatSteel Deflection Track**] [**Slotted Deflecto Track**].
  - 3) Steel Network Inc. (The); [**VertiClip SLD**] [**VertiTrack VTD**] Series.
  - 4) Superior Metal Trim; Superior Flex Track System (SFT).
  - 5) Telling Industries; [**Vertical Slip Track**] [**Vertical Slip Track II**].
  - 6) or approved equal.
- E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak System[ **attached to studs with Fire Trak Posi Klip**].
    - b. Grace Construction Products; FlameSafe FlowTrak System.
    - c. Metal-Lite, Inc.; The System.
    - d. **<Insert manufacturer>**
    - e. or approved equal.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [**0.027 inch** (0.68 mm)] [**0.033 inch** (0.84 mm)] **<Insert thickness>**.
- G. Cold-Rolled Channel Bridging: Steel, **0.053-inch** (1.34-mm) minimum base-metal thickness, with minimum **1/2-inch-** (13-mm-) wide flanges.
1. Depth: [**As indicated on Drawings**] [**1-1/2 inches** (38 mm)] **<Insert depth>**.
  2. Clip Angle: Not less than **1-1/2 by 1-1/2 inches** (38 by 38 mm), **0.068-inch-** (1.72-mm-) thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [**0.033 inch** (0.84 mm)] **<Insert thickness>**.
  2. Depth: [**As indicated on Drawings**] [**7/8 inch** (22.2 mm)] [**1-1/2 inches** (38.1 mm)].
- I. Resilient Furring Channels: **1/2-inch-** (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: [**Asymmetrical**] [**or**] [**hat shaped**].
- J. Cold-Rolled Furring Channels: **0.053-inch** (1.34-mm) uncoated-steel thickness, with minimum **1/2-inch-** (13-mm-) wide flanges.
1. Depth: [**As indicated on Drawings**] [**3/4 inch** (19 mm)] **<Insert depth>**.

2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of **0.033 inch** (0.8 mm).
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch-** (1.59-mm-) diameter wire, or double strand of **0.048-inch-** (1.21-mm-) diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches** (31.8 mm), wall attachment flange of **7/8 inch** (22 mm), minimum uncoated-metal thickness of **0.018 inch** (0.45 mm), and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch-** (1.59-mm-) diameter wire, or double strand of **0.048-inch-** (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to **[5] <Insert number>** times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: [**Cast-in-place anchor, designed for attachment to concrete forms**] [**Postinstalled, chemical anchor**] [**Postinstalled, expansion anchor**].
  2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to **[10] <Insert number>** times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
    - a. Powder-actuated fasteners shall be used only where allowed in advance by DEN Operations.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.16 inch** (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, [**in size indicated on Drawings**] [**1 by 3/16 inch** (25 by 5 mm) **by length indicated**] **<Insert size>**.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of **0.053 inch** (1.34 mm) and minimum **1/2-inch-** (13-mm-) wide flanges.
  1. Depth: [**As indicated on Drawings**] [**2-1/2 inches** (64 mm)] [**2 inches** (51 mm)] [**1-1/2 inches** (38 mm)].
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: **0.053-inch** (1.34-mm) uncoated-steel thickness, with

2. minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.  
Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.027 inch (0.68 mm)] [0.033 inch (0.84 mm)].
    - b. Depth: [**As indicated on Drawings**] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
  3. Dimpled Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.025 inch (0.64 mm)].
    - b. Depth: [**As indicated on Drawings**] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
  4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
    - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.033 inch (0.84 mm)] <Insert thickness>.
  5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
    - a. Configuration: [**Asymmetrical**] [or] [**hat shaped**].
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; Drywall Grid System.
    - c. USG Corporation; Drywall Suspension System.
    - d. <Insert manufacturer>
    - e. or approved equal.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide[ **one of**] the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch** (3.2 mm) thick, in width to suit steel stud size.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches** (610 mm) o.c.
  2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### **3.3 INSTALLATION, GENERAL**

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
  1. Gypsum Plaster Assemblies: Also, comply with requirements in ASTM C 841 that apply to framing installation.
  2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  3. Gypsum Veneer Plaster Assemblies: Also, comply with requirements in ASTM C 844 that apply to framing installation.

4. Gypsum Board Assemblies: Also, comply with requirements in ASTM C 840 that apply to framing installation.
    - B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with the most current edition of United States Gypsum Co. "Gypsum Construction Handbook."
    - C. Install bracing at terminations in assemblies.
    - D. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
    - E. Where building structure abuts ceiling perimeter or penetrates ceiling.
      1. Where partition framing and wall furring abut structure, except at floor.
      2. Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.
    - F. Install deflection track top runner to attain lateral support and avoid axial loading.
    - G. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.
    - H. Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
    - I. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- 3.4 INSTALLING FRAMED ASSEMBLIES
- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
  - B. Install studs so flanges within framing system point in same direction.
    1. Space studs as follows:
      - a. Single-Layer Application: [16 inches (406 mm)] [24 inches (610 mm)] [400 mm] [600 mm] o.c. unless otherwise indicated.
      - b. Multilayer Application: [16 inches (406 mm)] [24 inches (610 mm)] [400 mm] [600 mm] o.c. unless otherwise indicated.
      - c. Tile Backing Panels: [16 inches (406 mm)] [400 mm] o.c. unless otherwise indicated.
  - C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.



1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on doorframes; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch** (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches** (150 mm) o.c.
- D. Direct Furring:
1. Screw to wood framing.
  2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** (610 mm) o.c.
- E. Z-Furring Members:
1. Erect insulation (specified in Section 072100 "Thermal Insulation") vertically and hold in place with Z-furring members spaced [**24 inches** (610 mm)] [**600 mm**] o.c.
  2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** (610 mm) o.c.
  3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space

second member no more than **12 inches** (305 mm) from corner and cut insulation to fit.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch** (3 mm) from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards and seismic requirements for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within **[performance limits established by referenced installation standards]** <Insert deflection limit>.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems [**with hangers used for support**] **<Insert requirements>**.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within [**1/8 inch in 12 feet** (3 mm in 3.6 m)] **<Insert dimensions>** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.6 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: DEN Project Manager will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  - 1. Notify DEN Project Manager minimum [**seven (7)**] **<Insert number>** days in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
  - 2. Prior to notifying DEN Project Manager, complete the following in areas to receive gypsum board ceilings:
    - a. Installation of 80% of lighting fixtures, powered for operation.
    - b. Installation, insulation, and leak and pressure testing of water piping systems.
    - c. Installation of air duct systems.
    - d. Installation of air devices.
    - e. Installation of mechanical system control air tubing.
    - f. Installation of ceiling support framing.
    - g. **<Insert requirements.>**

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

- B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
5. Section 093000 "Tiling" for cementitious backer units installed as substrates for ceramic tile.

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

#### 1.3 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
    - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
  4. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
  5. Laboratory Test Reports for Credit IEQ 4: For adhesives used to laminate gypsum board panels to substrates, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings showing locations, details, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- D. Submit shop drawing showing locations, layout, and details of all metal trim.
- E. Samples: For the following products:
1. Trim Accessories: Full-size Sample in **12-inch-** (300-mm-) long length for each trim accessory indicated.
  2. Textured Finishes: [**Manufacturer's standard size**] **<Insert size>** for each textured finish indicated and on same backing indicated for Work.
- 1.4 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.5 QUALITY ASSURANCE
- A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board

and other panel products from a single manufacturer.

- B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials either from the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- C. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
  3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Intertek Testing Services, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Mockups: Before beginning gypsum board installation, install mockups of at least **100 sq. ft. (9 sq. m)** in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
    - b. Each texture finish indicated.
  2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  3. Simulate finished lighting conditions for review of mockups.
  4. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by DEN Project Manager.
  5. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
  6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. When directed, demolish and remove mockups from Project site.
  8. Subject to compliance with requirements and approval by DEN Project Manager, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are fully enclosed and conditioned on a 24-hour basis.
- C. Required Room Temperatures for Gypsum Panel Work:
  - 1. For nonadhesive attachment of gypsum board to framing, maintain not less than 40 degrees F (4 degrees C).
  - 2. For adhesive attachment and finishing of gypsum board, maintain not less than 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry.
  - 3. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- D. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- E. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- F. Protect all installed panels from moisture damage. Replace all panels that become wet or damaged.
- G. CONSTRUCTION WASTE MANAGEMENT
  - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to



ASTM E 119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Regional Materials: Gypsum panel products shall be manufactured within **500 miles (800 km)** of Project site.
- D. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Gypsum.
  - 2. CertainTeed Corp.
  - 3. Georgia-Pacific Gypsum LLC.
  - 4. Lafarge North America Inc.
  - 5. National Gypsum Company.
  - 6. PABCO Gypsum.
  - 7. Temple-Inland.
  - 8. USG Corporation.
  - 9. **<Insert manufacturer>**
  - 10. or approved equal.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
  - 1. Thickness: **[5/8" (15.9 mm)]**, Type X, unless otherwise indicated.
  - 2. Long Edges: **[Tapered] [Tapered and featured (rounded or beveled) for prefilling]**.

- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: **5/8 inch** (15.9 mm).
  2. Long Edges: **[Tapered] [Tapered and featured (rounded or beveled) for prefilling]**.
- D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Thickness: **1/4 inch** (6.4 mm).
  2. Long Edges: Tapered.
- E. Antia-Sag Gypsum Ceiling Board: ASTM C 1396/C 1396M.
1. Thickness: **1/2 inch** (12.7 mm).
  2. Long Edges: Tapered.
  3. Type: Anti-sag.
- F. Foil-Backed Gypsum Board: ASTM C 1396/C 1396M.
1. Core: **[As indicated on Drawings] [3/8 inch** (9.5 mm), **regular type] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings]**.
  2. Long Edges: **[Tapered] [Tapered and featured (rounded or beveled) for prefilling]**.
- G. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, **[Level 1] [Level 2] [Level 3]**.
1. Core: **[As indicated on Drawings] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X]**.
  2. Long Edges: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- H. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: **[As indicated] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X]**.
  2. Long Edges: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability. Brand and type of gypsum board to be comply with requirements of designated fire-rated assemblies.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Gypsum; Firebloc Type C.
    - b. CertainTeed Corp.; ProRoc Type C.
    - c. Georgia-Pacific Gypsum LLC; Fireguard C.
    - d. Lafarge North America Inc.; Firecheck Type C.
    - e. National Gypsum Company; Gold Bond Fire-Shield C.
    - f. PABCO Gypsum; Flame Curb Type Super C.
    - g. Temple-Inland; Type TG-C.
    - h. USG Corporation; Firecode C Core.
    - i. **<Insert manufacturer>**
    - j. or approved equal.
  2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
  3. Long Edges: Tapered.
- B. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
    - b. **<Insert manufacturer's name; product name or designation>**.
    - c. or approved equal.
  2. Core: **[As indicated]** [1/2 inch (12.7 mm), **regular type**] [1/2 inch (12.7 mm), **Type C**] [5/8 inch (15.9 mm), **Type X**] [5/8 inch (15.9 mm), **abuse resistant**].
  3. Long Edges: Tapered.
  4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. National Gypsum Company; Sound Break.
    - b. Quiet Solution, Quiet Rock.
    - c. **<Insert manufacturer>**
    - d. or approved equal
  2. Core: **[As indicated]** [1/2 inch (12.7 mm), **regular type**] [1/2 inch (12.7 mm), **Type X**] [5/8 inch (15.9 mm), **regular type**] [5/8 inch (15.9 mm), **Type X**] [1-3/8 inch (35 mm), **regular type**].
  3. Long Edges: Tapered.
- D. Skim-Coated Gypsum Board: ASTM C 1396/C 1396M. Manufactured with a factory-applied skim coat.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Lafarge North America Inc.; Rapid Deco L5.
  - b. or approved equal.
2. Core: [**As indicated**] [1/2 inch (12.7 mm), **regular type**] [5/8 inch (15.9 mm), **Type X**].
3. Long Edges: Tapered.

## 2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corp.
    - c. Georgia-Pacific Gypsum LLC.
    - d. Lafarge North America Inc.
    - e. National Gypsum Company.
    - f. PABCO Gypsum.
    - g. Temple-Inland.
    - h. USG Corporation.
    - i. <Insert manufacturer>
    - j. or approved equal.
  2. Core: [**As indicated**] [1/2 inch (12.7 mm), **regular type**] [5/8 inch (15.9 mm), **Type X**].
- B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; GlasRoc Sheathing.
    - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
    - c. National Gypsum Company; Gold Bond, e(2)XP.
    - d. USG Corporation; Securock Glass Mat Sheathing.
    - e. <Insert manufacturer>
    - f. or approved equal.
  2. Core: [**As indicated**] [1/2 inch (12.7 mm), **regular type**] [5/8 inch (15.9 mm), **Type X**].
- C. Cellulose Fiber-Reinforced Gypsum Sheathing Board: ASTM C 1278/C 1278M, gypsum sheathing, with manufacturer's standard edges.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. USG Corporation; Fiberock Aqua-Tough.
  - b. <Insert manufacturer>
  - c. or approved equal.
2. Type and Thickness: [**Regular, 1/2 inch** (13 mm)] [**Type X, 5/8 inch** (15.9 mm)] thick.
  3. Size: [**48 by 96 inches** (1219 by 2438 mm)] [**48 by 108 inches** (1219 by 2743 mm)] [**48 by 120 inches** (1219 by 3048 mm)] [**1200 by 2400 mm**] [**1200 by 2750 mm**] [**1200 by 3050 mm**].

## 2.6 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; GlasRoc Tile Backer.
    - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
    - c. <Insert manufacturer>
    - d. or approved equal.
  2. Core: [**As indicated on Drawings**] [**1/2 inch** (12.7 mm), **regular type**] [**5/8 inch** (15.9 mm), **Type X**].
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; C-Cure Board 990.
    - b. CertainTeed Corp.; FiberCement [**Underlayment**] [**BackerBoard**].
    - c. FinPan, Inc.; [**Util-A-Crete Concrete Backer Board**] [**EZ Backer**] [**ProTEC**].
    - d. James Hardie Building Products, Inc.; [**Hardiebacker**] [**Hardiebacker 500**].
    - e. National Gypsum Company, Permabase Cement Board.
    - f. USG Corporation; DUROCK Cement Board.
    - g. <Insert manufacturer>
    - h. or approved equal.
  2. Thickness: [**1/2 inch** (12.7 mm)] [**5/8 inch** (15.9 mm)] [**As indicated**].
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
  1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. American Gypsum.
  - b. CertainTeed Corp.
  - c. Georgia-Pacific Gypsum LLC.
  - d. Lafarge North America Inc.
  - e. PABCO Gypsum.
  - f. Temple-Inland.
  - g. USG Corporation.
  - h. **<Insert manufacturer>**
  - i. or approved equal.
2. Core: **[As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings].**

## 2.7 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

1. Material: **[Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet] [Galvanized or aluminum-coated steel sheet or rolled zinc] [Plastic] [Paper-faced galvanized steel sheet].**
2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.
  - e. U-Bead: U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use where indicated.
  - f. Expansion (control) joint: One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
  - g. Curved-Edge Cornerbead: With notched or flexible flanges.
  - h. As indicated or required to achieve design intent.

### B. Exterior Trim: ASTM C 1047.

1. Material: Formed from steel sheet zinc coated by hot-dip process or rolled zinc complying with ASTM C1047, in shapes indicated below by reference to Fig. 1 designations in ASTM C1047.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
  - d. As indicated or required to achieve design intent.

- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fry Reglet Corp.
    - b. Gordon, Inc.
    - c. Pittcon Industries.
    - d. MM Systems, Inc.
    - e. **<Insert manufacturer>**
    - f. or approved equal.
  2. Aluminum: Alloy and temper with not less than the strength and durability properties of [ASTM B 221](#) (ASTM B 221M), Alloy 6063-T5.
  3. Finish:
    - a. Primed Finish: Manufacturer's standard corrosion-resistant primer compatible with joint compound and finish materials specified.
    - b. Class II, Clear Anodic Finish: AA-C12C22A31 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating with a minimum thickness of 0.01 mm).
    - c. Class II, Color Anodic Finish: AA-C12C22A32/A34 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color and a minimum coating thickness of 0.01 mm).
    - d. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel according to paint manufacturer's specifications for cleaning, conversion coating, and applying organic coating.
    - e. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
    - f. Color: **<As selected by DEN Project Manager from manufacturer's standard colors.> <Match color as provided by DEN Project Manager>**.

## 2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
  2. Exterior Gypsum Soffit Board: Paper.
  3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints[, **rounded or beveled panel edges,**] and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use [**setting-type taping**] [**drying-type, all-purpose**] compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use [**setting-type, sandable topping**] [**drying-type, all-purpose**] compound.
  4. Finish Coat: For third coat, use [**setting-type, sandable topping**] [**drying-type, all-purpose**] compound.
  5. Skim Coat: For final coat of Level 5 finish, use [**setting-type, sandable topping compound**] [**drying-type, all-purpose compound**] [**high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish**].
- D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
  2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  2. Cementitious Backer Units: As recommended by backer unit manufacturer.
  3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
- ## 2.9 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of [**50**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.



1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch** (0.84 to 2.84 mm) thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, nondrying, nonhardening, gunnable, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
    - b. Grabber Construction Products; Acoustical Sealant GSC.
    - c. Pecora Corporation; [**AC-20 FTR**] [**AIS-919**].
    - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    - e. USG Corporation; SHEETROCK Acoustical Sealant.
    - f. Tremco, Inc.; Tremco Acoustical Sealant.
    - g. Contech Brands; Chemrex, Inc.; PL Acoustical Sealant.
    - h. **<Insert manufacturer>**
    - i. or approved equal.
  2. Acoustical joint sealant shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Separation Between Steel Framing and Exterior Walls:
1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), nonperforated.
  2. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit metal stud size indicated.
- G. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- H. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

2.10 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Polystyrene.
    - b. National Gypsum Company; ProForm Perfect Spray.
    - c. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.
    - d. **<Insert manufacturer>**
    - e. or approved equal.
  2. Texture: [**Fine**] [**Medium**] [**Coarse**].
- C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Wall and Ceiling Spray Texture.
    - b. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Vermiculite.
    - c. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
    - d. **<Insert manufacturer>**
    - e. or approved equal.
  2. Texture: [**Light spatter**] [**Spatter knock-down**] **<Insert texture>**.
- D. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Easi-Tex Spray Texture.
    - b. National Gypsum Company; Perfect Spray EM Texture.
    - c. USG Corporation; BEADEX FasTex Wall and Ceiling Spray Texture.
    - d. **<Insert manufacturer>**
    - e. or approved equal.
  2. Texture: [**Orange Peel**] [**Spatter**] [**Spatter knock-down**] **<Insert texture>**.
- E. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. International Cellulose Corp.; SonaSpray "fc."
    - b. USG Corporation; USG Acoustical Plaster Finish.

- c. **<Insert manufacturer>**
  - d. or approved equal.
2. Application Thickness: [1/2 inch (12.7 mm)] **<Insert thickness>**.
3. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: [25] **<Insert value>** or less.
  - b. Smoke-Developed Index: [50] [450] **<Insert value>** or less.
4. NRC: [0.55] **<Insert NRC>** according to ASTM C 423.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected, and required environmental conditions have been achieved.

#### 3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
- B. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.
- C. Before sprayed-on fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches (600 mm) o.c.
- D. After sprayed-on fireproofing has been applied, remove only as much fireproofing as needed to complete installation of gypsum board assemblies without reducing thickness of fireproofing below that is required to obtain fire-resistance rating indicated. Protect remaining fireproofing from damage.

### 3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch** (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft.** (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch-** (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch-** (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for

locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- K. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  2. Fit gypsum panels accurately around ducts, pipes, and conduits.
  3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- L. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations, applicable code requirements.
1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- N. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
- O. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- P. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.

### 3.4 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Wallboard Type: **[As indicated on Drawings] [Vertical surfaces unless otherwise indicated].**
  2. Type X: **[As indicated on Drawings] [Where required for fire-resistance-rated assembly] [Vertical surfaces unless otherwise indicated] <Insert requirements>.**
  3. Flexible Type: **[As indicated on Drawings] [Apply in double layer at curved assemblies].**
  4. Ceiling Type: **[As indicated on Drawings] [Ceiling surfaces].**
  5. Foil-Backed Type: **[As indicated on Drawings] <Insert requirements>.**
  6. Abuse-Resistant Type: **[As indicated on Drawings] <Insert requirements>.**

7. Moisture- and Mold-Resistant Type: [**As indicated on Drawings**] <Insert requirements>.
  8. Type C: [**As indicated on Drawings**] [**Where required for specific fire-resistance-rated assembly indicated**].
  9. Glass-Mat Interior Type: [**As indicated on Drawings**] <Insert requirements>.
  10. Acoustically Enhanced Type: [**As indicated on Drawings**] <Insert requirements>.
  11. Skim-Coated Type: [**As indicated on Drawings**] <Insert requirements>.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  2. On partitions/walls, apply gypsum panels [**horizontally (perpendicular to framing)**] unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, **16 inches** (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
  2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  4. Fastening Methods: [**Fasten base layers and face layers separately to supports with screws**] [**Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners**].
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily

brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch-** (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws **16 inches** (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches** (300 mm) o.c.
3. Wet gypsum panels on surfaces that will become compressed when panels are installed over a curve and where curve radius prevents using dry panels. Comply with gypsum board manufacturer's recommendations relative to curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
4. Apply gypsum panels horizontally with wrapped edges perpendicular to studs. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around the curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches (300 mm) o.c.
5. Allow wetted gypsum panels to dry completely before applying joint treatment

3.5 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with **1/4-inch** (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.6 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at [**showers, tubs, and where indicated**] [**locations indicated to receive tile**]. Install with **1/4-inch** (6.4-mm) gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at [**showers, tubs, and where indicated**] [**locations indicated to receive tile**].
- C. Water-Resistant Backing Board: Install where indicated with **1/4-inch** (6.4-mm) gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.7 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control and Expansion Joints: Install control and expansion joints at locations indicated on Drawings, and in full accordance with ASTM C 840, and in specific locations approved by DEN Project Manager for visual effect.
1. Submit drawing showing locations and details of all control joints and expansion joints.
  2. If control joints are not fully indicated on Drawings, provide control joints and expansion joints in compliance with ASTM C 840, and indicate on shop drawing.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners[ **unless otherwise indicated**].
  2. Bullnose Bead: Use [**at outside corners**] [**where indicated**] **<Insert requirements>**.
  3. LC-Bead: Use [**at exposed panel edges**] **<Insert requirements>**.
  4. L-Bead: Use [**where indicated**] **<Insert requirements>**.
  5. U-Bead: Use [**at exposed panel edges**] [**where indicated**] **<Insert requirements>**.
  6. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
  2. LC-Bead: Use [**at exposed panel edges**] **<Insert requirements>**.
- E. Aluminum Trim: Install in locations [**indicated on Drawings**] **<Insert requirements>**.

### 3.8 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints[, **rounded or beveled edges**,] and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.



2. Level 2: **[Panels that are substrate for tile] [Panels that are substrate for acoustical tile] [Where indicated on Drawings] <Insert locations>**.
  3. Level 3: **[Where indicated on Drawings] <Insert locations>**.
  4. Level 4: **[At panel surfaces that will be exposed to view unless otherwise indicated] <Insert locations>**.
    - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting." Level 5 is suitable for surfaces receiving gloss and semigloss enamels and other surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.
  5. Level 5: **[Where indicated on Drawings] <Insert locations>**.
    - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.9 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[ **matching approved mockup and**] free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

### 3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: DEN Project Manager will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  1. Notify DEN Project Manager minimum [**seven (7)**] **<Insert number>** days in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.

2. Prior to notifying DEN Project Engineer, complete the following in areas to receive gypsum board ceilings:
  - a. Installation of [80%] <Insert number> of lighting fixtures, powered for operation.
  - b. Installation, insulation, and leak and pressure testing of water piping systems.
  - c. Installation of air duct systems.
  - d. Installation of air devices.
  - e. Installation of mechanical system control air tubing.
  - f. Installation of ceiling support framing.
  - g. <Insert requirements.>

### 3.11 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 092900

## SECTION 093000 - TILING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Tile backing panels.
6. Metal edge strips.

- B. Related Sections:

1. **[Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"]** for waterproofing under thickset mortar beds.
2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 092400 "Portland Cement Plastering" for Portland cement scratch coat over metal lath on wall surfaces.
4. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
5. Section 092900 "Gypsum Board" for **[cementitious backer units] [glass-mat, water-resistant backer board]**.
6. Section 093033 "Stone Tiling."
7. Section 096340 "Stone Flooring" for stone thresholds.

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

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
  - 1. Level Surfaces: Minimum <Insert required static coefficient of friction>.
  - 2. Step Treads: Minimum <Insert required static coefficient of friction>.
  - 3. Ramp Surfaces: Minimum <Insert required static coefficient of friction>.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
  - 2. Product Data for Credit IEQ 4.3: For **[adhesives] [and] [grouts]**, documentation including printed statement of VOC content.
  - 3. Product Data for Credit IEQ 4.3: For tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  - 4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [tile flooring systems]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.[ **For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.**]
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least [12 inches (300 mm) **square**] <Insert size>, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory[ **for each color and finish required**].
4. Stone thresholds in 6-inch (150-mm) lengths.
5. Metal edge strips in 6-inch (150-mm) lengths.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product[ **and special purpose tile**].

#### 1.7 CLOSEOUT SUBMITTALS

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

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Tile and Trim Units:[ **Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.**]
    - a. <Insert, in separate subparagraphs, tile-type designation or description and quantity required for each category of tile for which extra material is required>.
  2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

## 1.9 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain **[tile of each type and color or finish] [tile of each type] [tile of each color or finish] [tile]** from one source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
  2. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Stone thresholds.
  2. Waterproof membrane.
  3. Crack isolation membrane.
  4. Joint sealants.
  5. Cementitious backer units.
  6. Metal edge strips.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of **[each type of]** floor tile installation.
  2. Build mockup of **[each type of]** wall tile installation.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

#### 1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.12 CONSTRUCTION WASTE MANAGEMENT

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

### **PART 2 - PRODUCTS**

#### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.
- D. Low-Emitting Materials: Tile flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

- F. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation [**in swimming pools**] [**on exteriors**] [**or**] [**in wet areas**], do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.2 TILE PRODUCTS

- A. Tile Type [**CT-#**]: Factory-mounted [**unglazed**] [**glazed**] ceramic mosaic tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Olean; Division of Dal-Tile International Inc.
    - b. Crossville, Inc.
    - c. Daltile; Division of Dal-Tile International Inc.
    - d. Deutsche Steinzeug America, Inc.
    - e. Interceramic.
    - f. Lone Star Ceramics Company.
    - g. Grupo Porcelanite.
    - h. Portobello America, Inc.
    - i. Seneca Tiles, Inc.
    - j. **<Insert manufacturer's name>**.
    - k. or approved equal.
  2. Composition: [**Porcelain**] [**Impervious natural clay or porcelain**] [**Vitreous or impervious natural clay or porcelain**].
  3. Module Size: [**1 by 1 inch** (25.4 by 25.4 mm)] [**1 by 2 inches** (25.4 by 50.8 mm)] [**2 by 2 inches** (50.8 by 50.8 mm)] **<Insert size>**.
  4. Thickness: **1/4 inch** (6.35 mm).
  5. Face: [**Plain**] [**Pattern of design indicated**,] with cushion edges.
  6. Surface: [**Smooth, without**] [**Slip-resistant, with**] abrasive admixture.
  7. Finish: [**Bright, opaque**] [**Bright, clear**] [**Mat, opaque**] [**Mat, clear**] [**Semimat, opaque**] [**Semimat, clear**] [**Vellum, opaque**] [**Vellum, clear**] [**Crystalline**] **<Insert description>** glaze.
  8. Tile Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color and pattern>**.
  9. Grout Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.



10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[ **and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
- a. Base Cove: Cove, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
  - b. Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
  - c. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
  - d. Wainscot Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
  - e. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
  - f. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
  - g. External Corners for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
  - h. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
  - i. Internal Corners: Cove, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
  - j. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
  - k. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.35 mm) across nominal 4-inch (100-mm) dimension.

B. Tile Type [CT-<#>]: [Unglazed] [Glazed] square-edged quarry tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Olean; Division of Dal-Tile International Inc.
  - b. Atlas Minerals & Chemicals, Inc.
  - c. Daltile; Division of Dal-Tile International Inc.
  - d. Deutsche Steinzeug America, Inc.
  - e. Endicott Tile Ltd.; Endicott Clay Products Co.
  - f. Florida Brick & Clay Company Inc.
  - g. Florida Tile Industries, Inc.
  - h. Interceramic.
  - i. Metropolitan Ceramics.

- j. Portobello America, Inc.
  - k. Quarry Tile Co.
  - l. Seneca Tiles, Inc.
  - m. Summitville Tiles, Inc.
  - n. United States Ceramic Tile Company.
  - o. **<Insert manufacturer's name>**.
  - p. or approved equal.
2. Face Size: [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] [6 by 3 inches (152 by 76 mm)] [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] [8 by 8 inches (203 by 203 mm)] **<Insert size>**.
  3. Thickness: [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)] [3/4 inch (19 mm)].
  4. Wearing Surface: [Nonabrasive, smooth] [Abrasive aggregate embedded in surface] **<Insert description>**.
  5. Finish: [Bright, opaque] [Bright, clear] [Mat, opaque] [Mat, clear] [Semimat, opaque] [Semimat, clear] [Vellum, opaque] [Vellum, clear] [Crystalline] **<Insert description>** glaze.
  6. Tile Color and Pattern: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color and pattern>**.
  7. Grout Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.
  8. For furan-grouted quarry tile, precoat with temporary protective coating.
  9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[ **and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Base: Coved[ **with surface bullnose top edge**], face size [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] **<Insert size>**.
    - b. Wainscot Cap: Surface bullnose, face size [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] **<Insert size>**.
    - c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
- C. Tile Type [CT-<#>]: [Unglazed] [Glazed] paver tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Marazzi Tile, Inc.
    - b. American Olean; Division of Dal-Tile International Inc.
    - c. Crossville, Inc.
    - d. Daltile; Division of Dal-Tile International Inc.
    - e. Deutsche Steinzeug America, Inc.
    - f. Florida Tile Industries, Inc.
    - g. Florim USA.
    - h. GranitiFiandre; c/o Trans Ceramica, Ltd.
    - i. Interceramic.

- j. Laufen.
  - k. Lone Star Ceramics Company.
  - l. Grupo Porcelanite.
  - m. Portobello America, Inc.
  - n. Seneca Tiles, Inc.
  - o. United States Ceramic Tile Company.
  - p. <Insert manufacturer's name>.
  - q. or approved equal.
2. Composition: [Porcelain] [Impervious natural clay or porcelain] [Vitreous or impervious natural clay or porcelain] [Natural clay or porcelain].
  3. Face Size: [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] [6 by 6 inches (152 by 152 mm)] [7-3/4 by 3-7/8 inches (197 by 98 mm)] [7-7/8 by 7-7/8 inches (200 by 200 mm)] [11-13/16 by 11-13/16 inches (300 by 300 mm)] [165 by 333 mm] [200 by 250 mm] [250 by 250 mm] [165 by 333 mm] [333 by 333 mm] [400 by 400 mm] <Insert size>.
  4. Thickness: [1/4 inch (6.35 mm)] [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)].
  5. Face: [Plain with square or cushion edges] [Plain with square edges] [Plain with cushion edges] [Pattern of design indicated, with square or cushion edges] [As indicated].
  6. Finish: [Bright, opaque] [Bright, clear] [Mat, opaque] [Mat, clear] [Semimat, opaque] [Semimat, clear] [Vellum, opaque] [Vellum, clear] [Crystalline] <Insert description> glaze.
  7. Tile Color and Pattern: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and pattern>.
  8. Grout Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
  9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[ **and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Base Cove: Cove, module size [same as adjoining flat tile] <Insert size>.
    - b. Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [same as adjoining flat tile] <Insert size>.
    - c. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.
    - d. Wainscot Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [same as adjoining flat tile] <Insert size>.
    - e. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.
    - f. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
    - g. External Corners for Portland Cement Mortar Installations: Bead (bullnose), module size [same as adjoining flat tile] <Insert size>.
    - h. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.

- i. Internal Corners: Cove, module size [**same as adjoining flat tile**] <Insert size>.
- j. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- k. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from **1/2 to 1/4 inch** (12.7 to 6.35 mm) across nominal **4-inch** (100-mm) dimension.

D. Tile Type [**CT-<#>**]: [**Glazed wall tile**] [**Decorative thin wall tile**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Marazzi Tile, Inc.
  - b. American Olean; Division of Dal-Tile International Inc.
  - c. Daltile; Division of Dal-Tile International Inc.
  - d. Deutsche Steinzeug America, Inc.
  - e. Florida Tile Industries, Inc.
  - f. Florim USA.
  - g. Laufen.
  - h. Grupo Porcelanite.
  - i. Portobello America, Inc.
  - j. Seneca Tiles, Inc.
  - k. United States Ceramic Tile Company.
  - l. <Insert manufacturer's name>.
  - m. or approved equal.
2. Module Size: [**4-1/4 by 4-1/4 inches** (108 by 108 mm)] [**6 by 4-1/4 inches** (152 by 108 mm)] [**6 by 6 inches** (152 by 152 mm)] [**200 by 200 mm**] [**250 by 250 mm**] [**200 by 300 mm**] <Insert size>.
3. Thickness: **5/16 inch** (8 mm).
4. Face: [**Plain with modified square edges or cushion edges**] [**Plain with modified square edges**] [**Plain with cushion edges**] [**Pattern of design indicated, with manufacturer's standard edges**].
5. Finish: [**Bright, opaque**] [**Bright, clear**] [**Mat, opaque**] [**Mat, clear**] [**Semimat, opaque**] [**Semimat, clear**] [**Vellum, opaque**] [**Vellum, clear**] [**Crystalline**] <Insert description> glaze.
6. Tile Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
7. Grout Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
8. Mounting: Factory, back mounted.
9. Mounting: Pregouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[ **and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:

- a. Base for Portland Cement Mortar Installations: Coved, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 3-3/4 inches (152 by 95 mm)] <Insert size>.
  - b. Base for Thin-Set Mortar Installations: Straight, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
  - c. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
  - d. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
  - e. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
  - f. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm) unless otherwise indicated.
  - g. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
  - h. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
- E. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as adjoining wall tile.
1. One soap holder[ **with grab handle**] for each shower and tub indicated.
  2. One paper holder at each water closet.
  3. Color and Finish: [**Match adjoining glazed wall tile**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**White, bright glaze**] <Insert color and finish>.

## 2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C 615, with [**polished**] [**honed**] <Insert finish> finish.
1. Description: Uniform, [**fine**] [**medium**]-grained, [**white**] [**gray**] [**black**] <Insert color> stone without veining.
  2. Description: Match DEN Project Manager's sample.
  3. Description: Provide[ **one of**] the following:

- a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**
- C. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of [10] [12] per ASTM C 1353 or ASTM C 241 and with honed finish.
  1. Description: Uniform, fine- to medium-grained white stone with gray veining.
  2. Description: Match DEN Project Manager's sample.
  3. Description: Provide[ **one of**] the following:
    - a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**
- D. Slate Thresholds: ASTM C 629, Classification [I Exterior] [II Interior], with fine, even grain and honed finish.
  1. Description: Uniform, [black] [blue-black] [gray] [blue-gray] [green] **<Insert color>** stone[ **and unfading**].
  2. Description: Match DEN Project Manager's sample.
  3. Description: Provide[ **one of**] the following:
    - a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; C-Cure Board 990.
    - b. Custom Building Products; Wonderboard.
    - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    - d. USG Corporation; DUROCK Cement Board.
    - e. **<Insert manufacturer's name; product name or designation>.**
    - f. or approved equal.
  2. Thickness: [1/4 inch (6.4 mm)] [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm)] [**As indicated**].
- B. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FiberCement [**Underlayment**] [**BackerBoard**].
    - b. James Hardie; [**Hardiebacker**] [**Hardiebacker 500**].
    - c. **<Insert manufacturer's name; product name or designation>.**
    - d. or approved equal.

2. Thickness: [1/4 inch (6.4 mm)] [1/2 inch (12.7 mm)] [**As indicated**].

## 2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product[, **selected from the following**,] that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Noble Company (The); Nobleseal TS.
    - b. **<Insert manufacturer's name; product name or designation>**.
    - c. or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; 0.040-inch (1.01-mm) nominal thickness.
  1. Compotite Corporation; Composeal Gold.
  2. **<Insert manufacturer's name; product name or designation>**.
  3. or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Schluter Systems L.P.; KERDI.
    - b. **<Insert manufacturer's name; product name or designation>**.
    - c. or approved equal.
- E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. National Applied Construction Products, Inc.; Strataflex.
    - b. **<Insert manufacturer's name; product name or designation>**.
    - c. or approved equal.
- F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products; a QEP company; Elastiment 344 Reinforced

- b. Waterproofing and Anti-Fracture/Crack Suppression Membrane.
  - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
  - c. Bostik, Inc.; Hydroment Blacktop 90210.
  - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
  - e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
  - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
  - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
  - h. Summitville Tiles, Inc.; S-9000.
  - i. **<Insert manufacturer's name; product name or designation>**.
  - j. or approved equal.
  
- G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products; a QEP company; Elastiment 644 Membrane Waterproofing System.
    - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane.
    - c. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
    - d. C-Cure; Pro-Red Waterproofing Membrane 63.
    - e. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
    - f. Jamo Inc.; Waterproof.
    - g. Laticrete International, Inc.; [**Latapoxy 24hr HydroProofing**] [**Laticrete Watertight Floor N' Wall Waterproofing**].
    - h. MAPEI Corporation; Mapelastic HPG.
    - i. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
    - j. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
    - k. **<Insert manufacturer's name; product name or designation>**.
    - l. or approved equal.
  
- H. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products; a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.
    - b. C-Cure; UltraCure 971.
    - c. MAPEI Corporation; Mapelastic (PRP 315).
    - d. Southern Grouts & Mortars, Inc.; Southcrete 1100.
    - e. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
    - f. **<Insert manufacturer's name; product name or designation>**.
    - g. or approved equal.



- I. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),**], [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
    - b. <Insert manufacturer's name; product name or designation>.
    - c. or approved equal.

## 2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.12 for [**standard**] [**high**] performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch** (0.76-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Noble Company (The); Nobleseal CIS.
    - b. <Insert manufacturer's name; product name or designation>.
    - c. or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch** (1.01-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Compositite Corporation; Composeal Gold.
    - b. <Insert manufacturer's name; product name or designation>.
    - c. or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch** (0.203-mm) nominal thickness.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Schluter Systems L.P.; KERDI.
    - b. <Insert manufacturer's name; product name or designation>.
    - c. or approved equal.

- E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; **3/16-inch** (4-mm) nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Schluter Systems L.P.; DITRA.
    - b. **<Insert manufacturer's name; product name or designation>**.
    - c. or approved equal.
- F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; **0.040-inch** (1.01-mm) nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. MAPEI Corporation; Mapelastic SM.
    - b. National Applied Construction Products, Inc.; Strataflex.
    - c. **<Insert manufacturer's name; product name or designation>**.
    - d. or approved equal.
- G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
    - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
    - c. Bostik, Inc.; Hydroment Blacktop 90210.
    - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - e. Laticrete International, Inc.; Laticrete [**Blue 92 Anti-Fracture Membrane**] [**9235 Waterproof Membrane**].
    - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
    - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
    - h. Summitville Tiles, Inc.; S-9000.
    - i. **<Insert manufacturer's name; product name or designation>**.
    - j. or approved equal.
- H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
    - b. C-Cure; [**CureLastic 949**] [**Pro-Red Waterproofing Membrane 963**].
    - c. Custom Building Products; [**Redgard Waterproofing and Crack Prevention Membrane**] [**FractureFree Crack Prevention Membrane**] [**Semco Crack Prevention Membrane**].
    - d. Jamo Inc.; Waterproof.

- e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
  - f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
  - g. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
  - h. <Insert manufacturer's name; product name or designation>.
  - i. or approved equal.
- I. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; UltraCure 971.
    - b. MAPEI Corporation; Mapelastic (PRP 315).
    - c. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
    - d. <Insert manufacturer's name; product name or designation>.
    - e. or approved equal.
- J. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
    - b. <Insert manufacturer's name; product name or designation>.
    - c. or approved equal.

## 2.7 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
  - 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
  - 3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.
    - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication

- into lath.
  - b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
  - c. Configuration over Studs and Furring: Flat.
  - d. Configuration over Solid Surfaces: Self furring.
  - e. Weight: [2.5 lb/sq. yd. (1.4 kg/sq. m)] [3.4 lb/sq. yd. (1.8 kg/sq. m)].
4. Latex Additive: **[Manufacturer's standard] [acrylic resin] [or] [styrene-butadiene-rubber]** water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.
- B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.
    - j. Summitville Tiles, Inc.
    - k. TEC; a subsidiary of H. B. Fuller Company.
    - l. **<Insert manufacturer's name>**.
    - m. or approved equal.
  - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Mer-Kote Products, Inc.
    - j. Southern Grouts & Mortars, Inc.

- k. Summitville Tiles, Inc.
      - l. TEC; a subsidiary of H. B. Fuller Company.
      - m. **<Insert manufacturer's name>**.
      - n. or approved equal.
    2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
    3. Provide prepackaged, dry-mortar mix combined with **[acrylic resin] [or] [styrene-butadiene-rubber]** liquid-latex additive at Project site.
    4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
  - D. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of **[5/8 inch (16 mm)] <Insert thickness>**.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Bonsal American; an Oldcastle company.
      - b. Bostik, Inc.
      - c. C-Cure.
      - d. Custom Building Products.
      - e. Jamo Inc.
      - f. Laticrete International, Inc.
      - g. MAPEI Corporation.
      - h. Mer-Kote Products, Inc.
      - i. Southern Grouts & Mortars, Inc.
      - j. Summitville Tiles, Inc.
      - k. TEC; a subsidiary of H. B. Fuller Company.
      - l. **<Insert manufacturer's name>**.
      - m. or approved equal.
    2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
    3. Provide prepackaged, dry-mortar mix combined with **[acrylic resin] [or] [styrene-butadiene-rubber]** liquid-latex additive at Project site.
  - E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thin Set): ANSI A118.11.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Bonsal American; an Oldcastle company.
      - b. Bostik, Inc.
      - c. C-Cure.
      - d. Custom Building Products.
      - e. Jamo Inc.
      - f. Laticrete International, Inc.

- g. MAPEI Corporation.
    - h. Southern Grouts & Mortars, Inc.
    - i. Summitville Tiles, Inc.
    - j. TEC; a subsidiary of H. B. Fuller Company.
    - k. <Insert manufacturer's name>.
    - l. or approved equal.
  2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  3. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.
- F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3[.], **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**[, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Minerals & Chemicals, Inc.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Mer-Kote Products, Inc.
    - j. Southern Grouts & Mortars, Inc.
    - k. Summitville Tiles, Inc.
    - l. TEC; a subsidiary of H. B. Fuller Company.
    - m. <Insert manufacturer's name>.
    - n. or approved equal.
  2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.
- G. Chemical-Resistant Furan Mortar: ANSI A118.5, with [carbon] <Insert material> filler.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Minerals & Chemicals, Inc.
    - b. <Insert manufacturer's name>.
    - c. or approved equal.

- H. Organic Adhesive: ANSI A136.1, Type I.[.], **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).[, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bonsal American; an Oldcastle company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. DAP Inc.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.
    - j. Summitville Tiles, Inc.
    - k. TEC; a subsidiary of H. B. Fuller Company.
    - l. **<Insert manufacturer's name>**.
    - m. or approved equal.

## 2.8 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.
    - j. Summitville Tiles, Inc.
    - k. TEC; a subsidiary of H. B. Fuller Company.
    - l. **<Insert manufacturer's name>**.
    - m. or approved equal.
- C. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.
    - j. Summitville Tiles, Inc.
    - k. TEC; a subsidiary of H. B. Fuller Company.
    - l. <Insert manufacturer's name>.
    - m. or approved equal.
  2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
  3. Polymer Type: [**Acrylic resin**] [or] [**styrene-butadiene rubber**] in liquid-latex form for addition to prepackaged dry-grout mix.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Minerals & Chemicals, Inc.
    - b. Boiardi Products; a QEP company.
    - c. Bonsal American; an Oldcastle company.
    - d. Bostik, Inc.
    - e. C-Cure.
    - f. Custom Building Products.
    - g. Jamo Inc.
    - h. Laticrete International, Inc.
    - i. MAPEI Corporation.
    - j. Mer-Kote Products, Inc.
    - k. Southern Grouts & Mortars, Inc.
    - l. Summitville Tiles, Inc.
    - m. TEC; a subsidiary of H. B. Fuller Company.
    - n. <Insert manufacturer's name>.
    - o. or approved equal.
  2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to **140 deg F** (60 deg C) and **212 deg F** (100 deg C), respectively, and certified by manufacturer for intended use.
- E. Chemical-Resistant Furan Grout: ANSI A118.5, with carbon filler[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atlas Minerals & Chemicals, Inc.
  - b. **<Insert manufacturer's name>**.
  - c. or approved equal.

F. Grout for PregROUTed Tile Sheets: Same product used in factory to pregROUT tile sheets.

## 2.9 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

B. Retain first subparagraph below if required for LEED-NC, or LEED-CI, or LEED-CS Credit IEQ 4.1.

1. Sealants shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

C. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

D. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. DAP Inc.; **[Titanium Enriched Kitchen and Bath Sealant] [100 percent Silicone Kitchen and Bath Sealant]**.
  - b. Dow Corning Corporation; Dow Corning 786.
  - c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
  - d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
  - e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
  - f. Tremco Incorporated; Tremsil 600 White.
  - g. **<Insert manufacturer's name; product name or designation>**.
  - h. or approved equal.

E. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class

25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Bostik, Inc.; Chem-Calk 550.
  - b. Degussa Building Systems; Sonneborn Sonolastic SL 2.
  - c. Pecora Corporation; [**Dynatrol II-SG**] [**NR-200 Urexpan**].
  - d. Sika Corporation; Sikaflex-2c SL.
  - e. Tremco Incorporated.; [**THC-900**] [**THC-901**] [**Vulkem 245**].
  - f. **<Insert manufacturer's name; product name or designation>**.
  - g. or approved equal.

F. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atlas Minerals & Chemicals, Inc.
  - b. **<Insert manufacturer's name>**.
  - c. or approved equal.

## 2.10 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; [**half-hard brass**] [**white zinc alloy**] [**nickel silver**] [**stainless-steel, ASTM A 666, 300 Series**] exposed-edge material.
- C. Temporary Protective Coating: [**Either product**] [**Product**] indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
  1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of **120 to 140 deg F** (49 to 60 deg C) per ASTM D 87.
  2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated

by tile and grout manufacturers.

- E. Grout Sealer: Manufacturer's standard[ **silicone**] product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bonsal American; an Oldcastle company; Grout Sealer.
    - b. Bostik, Inc.; CeramaSeal [**Grout & Tile Sealer**] [**Magic Seal**] [**Silox 8**] [**Siloxane 220**].
    - c. C-Cure; Penetrating Sealer 978.
    - d. Custom Building Products; [**Surfaceguard**] [**Grout and Tile**] [**Grout**] Sealer.
    - e. Jamo Inc.; [**Matte Finish**] [**Penetrating**] Sealer.
    - f. MAPEI Corporation; KER [**003, Silicone Spray Sealer for Cementitious Tile Grout**] [**004, Keraseal Penetrating Sealer for Unglazed Grout and Tile**].
    - g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
    - h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
    - i. TEC; a subsidiary of H. B. Fuller Company; [**TA-256 Penetrating Silicone**] [**TA-257 Silicone**] Grout Sealer.
    - j. or approved equal.

## 2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with **[adhesives] [bonded mortar bed] [or] [thin-set mortar]** comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with DEN Project Manager.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with **[adhesives] [or] [thin-set mortar]** with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

- a. Exterior tile floors.
  - b. Tile floors in wet areas.
  - c. Tile swimming pool decks.
  - d. Tile floors in laundries.
  - e. Tile floors composed of tiles **8 by 8 inches** (200 by 200 mm) or larger.
  - f. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: **1/16 inch** (1.6 mm).
  2. Quarry Tile: [**1/4 inch** (6.35 mm)] [**3/8 inch** (9.5 mm)].
  3. Paver Tile: [**1/4 inch** (6.35 mm)] [**3/8 inch** (9.5 mm)].
  4. Glazed Wall Tile: **1/16 inch** (1.6 mm).
  5. Decorative Thin Wall Tile: **1/16 inch** (1.6 mm).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
  - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
  - 2. Do not extend **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** under thresholds set in **[dry-set Portland cement] [or] [latex-Portland cement]** mortar. Fill joints between such thresholds and adjoining tile set on **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** with elastomeric sealant.
- J. Metal Edge Strips: Install **[at locations indicated] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated]**.
- K. Grout Sealer: Apply grout sealer to **[cementitious]** grout joints **[in tile floors]** according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

#### 3.4 TILE BACKING PANEL INSTALLATION

- A. Install **[cementitious backer units] [and] [fiber-cement underlayment]** and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. **[ Use latex-Portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.]**

#### 3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

#### 3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove [**epoxy**] [**and**] [**latex-Portland cement**] grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.8 EXTERIOR TILE INSTALLATION SCHEDULE

- A. Exterior Floor Installations:
1. Tile Installation F101: Cement mortar bed (thickset) [**bonded to concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated**]; TCA F101 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
  2. Tile Installation F102: Thin-set mortar [**on concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated**]; TCA F102.
    - a. Tile Type: <Insert tile-type designation>.

- b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
- c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.

B. Exterior Wall Installations, Masonry or Concrete:

- 1. Tile Installation W201: Cement mortar bed (thickset) on metal lath over waterproof membrane; TCA W201 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Bond Coat Mortar for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
  - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- 2. Tile Installation W202: Thin-set mortar; TCA W202.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.

3.9 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

- 1. Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- 2. Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
  - a. Tile Type: **<Insert tile-type designation>**.



- b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
3. Tile Installation F113: Thin-set mortar; TCA F113.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
4. Tile Installation F114: Cement mortar bed (thickset) with cleavage membrane; **[epoxy] [furan]** grout; TCA F114 and ANSI A108.1B.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Water-cleanable epoxy] [Chemical-resistant furan]** grout.
5. Tile Installation F115: Thin-set mortar; **[epoxy] [furan]** grout; TCA F115.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Water-cleanable epoxy] [Chemical-resistant furan]** grout.
6. Tile Installation F116: **[Organic adhesive] [Water-cleanable, tile-setting epoxy]**; TCA F116.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
7. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
8. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.

- a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: [Latex-] [Medium-bed, latex-] Portland cement mortar.
  - c. Grout: Polymer-modified [sanded] [unsanded] grout.
9. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
- a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: [Latex-] [Medium-bed, latex-] Portland cement mortar.
  - c. Grout: [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
10. Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.
- a. Tile Type: <Insert tile-type designation>.
  - b. Grout: Water-cleanable epoxy grout.
11. Tile Installation F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed [bonded to concrete subfloor] [installed over cleavage membrane]; epoxy grout; TCA F132.
- a. Tile Type: <Insert tile-type designation>.
  - b. Grout: Water-cleanable epoxy grout.
12. Tile Installation F133: [Chemical-resistant furan mortar] [Water-cleanable, tile-setting epoxy]; furan grout. TCA F133[ except use water-cleanable, tile-setting epoxy instead of chemical-resistant furan mortar for setting tile].
- a. Tile Type: <Insert tile-type designation>.
  - b. Grout: Chemical-resistant furan grout.
- B. Interior Floor Installations, Wood Subfloor:
1. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.
    - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
  2. Tile Installation F141: Cement mortar bed (thickset) with cleavage membrane; TCA F141 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.

- c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  3. Tile Installation F142: Organic adhesive; TCA F142.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  4. Tile Installation F143: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F143.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Grout: Water-cleanable epoxy grout.
  5. Tile Installation F144: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA F144.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  6. Tile Installation F150/160: Thin-set mortar on exterior-glue plywood; TCA F150 or TCA F160.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
- C. Interior Radiant Heat Floor Installations, Concrete Subfloor:
  1. Tile Installation RH110: Thin-set mortar on crack isolation membrane; hydronic piping installed in concrete; TCA RH110.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  2. Tile Installation RH115: Thin-set mortar; electric radiant system encapsulated in thin-set mortar; TCA RH115.
    - a. Tile Type: <**Insert tile-type designation**>.

- b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
      - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  3. Tile Installation RH116: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH116.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    - c. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
- D. Interior Radiant Heat Floor Installations, Wood Subfloor:
  1. Tile Installation RH130: Thin-set mortar on exterior-glue plywood; electric radiant system encapsulated in thin-set mortar; TCA RH130.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  2. Tile Installation RH135: Thin-set mortar on cementitious backer units or fiber cement underlayment; electric radiant system encapsulated in thin-set mortar; TCA RH135.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  3. Tile Installation RH140: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH140.
    - a. Tile Type: <**Insert tile-type designation**>.
    - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    - c. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.

E. Interior Wall Installations, Masonry or Concrete:

1. Tile Installation W202: Thin-set mortar; TCA W202.
  - a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.
  - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
2. Tile Installation W211: Cement mortar bed (thickset) bonded to substrate; TCA W211 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
  - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
3. Tile Installation W221: Cement mortar bed (thickset) on metal lath[ **over waterproof membrane**]; TCA W221 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
  - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
4. Tile Installation W222: One-coat cement mortar bed (thickset) on metal lath[ **over waterproof membrane**]; TCA W222 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
  - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
5. Tile Installation W223: Organic adhesive; TCA W223.

- a. Tile Type: <Insert tile-type designation>.
- b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.

F. Interior Wall Installations, Wood Studs or Furring:

1. Tile Installation W221: Cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
2. Tile Installation W222: One-coat cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
  - a. Tile Type: <Insert tile-type designation>.
  - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Tile Installation W231: Cement mortar bed (thickset); TCA W231 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.

- d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
5. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
    - a. Tile Type: **<Insert tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
  6. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment **[ over cleavage membrane]**; TCA W244.
    - a. Tile Type: **<Insert tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  7. Tile Installation W245: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant gypsum backer board; TCA W245.
    - a. Tile Type: **<Insert tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- G. Interior Wall Installations, Metal Studs or Furring:
1. Tile Installation W221: Cement mortar bed (thickset) **[ over waterproof membrane]** on solid backing; TCA W221 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
    - a. Tile Type: **<Insert tile-type designation>**.
    - b. Bond Coat Mortar for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  2. Tile Installation W222: One-coat cement mortar bed (thickset) **[ over waterproof membrane]** on solid backing; TCA W222 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
    - a. Tile Type: **<Insert tile-type designation>**.

- b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
  - a. Tile Type: <**Insert tile-type designation**>.
  - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Tile Installation W241: Cement mortar bed (thickset); TCA W241 and ANSI A108.1B.
  - a. Tile Type: <**Insert tile-type designation**>.
  - b. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
5. Tile Installation W242: Organic adhesive on gypsum board; TCA W242.
  - a. Tile Type: <**Insert tile-type designation**>.
  - b. Grout: [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
6. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
  - a. Tile Type: <**Insert tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
7. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment[ **over cleavage membrane**]; TCA W244.
  - a. Tile Type: <**Insert tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
8. Tile Installation W245: [**Thin-set mortar**] [**Organic adhesive**] on coated glass-mat, water-resistant gypsum backer board; TCA W245.



- a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
  - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
- H. Bathtub Wall Installations, [Wood] [Metal] Studs or Furring:
1. Tile Installation B413: [Thin-set mortar] [Organic adhesive] on water-resistant gypsum board; TCA B413.
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
    - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
- I. Bathtub/Shower Wall Installations, [Wood] [Metal] Studs or Furring:
1. Tile Installation B411: Cement mortar bed (thickset); TCA B411 and ANSI A108.1A.
    - a. Tile Type: <Insert tile-type designation>.
    - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
    - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
  2. Tile Installation B412: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B412.
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
    - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
  3. Tile Installation B419: [Thin-set mortar] [Organic adhesive] on coated glass-mat, water-resistant backer board; TCA B419.
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
    - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
- J. Shower Receptor and Wall Installations, Concrete or Masonry:
1. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and [ANSI

**A108.1A] [ANSI A108.1B] [ANSI A108.1C].**

- a. Tile Type: <Insert tile-type designation>.
  - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
2. Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
- a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: Latex-Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
3. Tile Installation B422: Thin-set mortar on waterproof membrane with integrated bonding flange for bonded membranes; TCA B422.
- a. Tile Type: <Insert tile-type designation>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- K. Shower Receptor and Wall Installations, [**Wood**] [**Metal**] Studs or Furring:
1. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Tile Type: <Insert tile-type designation>.
    - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
  2. Tile Installation B415: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B415.
    - a. Tile Type: <Insert tile-type designation>.
    - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.

3. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set]** **[Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.
  
4. Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment; TCA B421.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: Latex-Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.
  
5. Tile Installation B422: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment with integrated bonding flange for bonded membranes; TCA B422.
  - a. Tile Type: **<Insert tile-type designation>**.
  - b. Thin-Set Mortar: Latex-Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 093000

## SECTION 093033 - STONE TILING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Dimension stone tile and related setting materials applied to **[floors] [and] [walls]**.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Tile backing panels.
6. Metal edge strips.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
2. **[Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"]** for waterproofing under thickset mortar beds.
3. Section 092400 "Portland Cement Plastering" for Portland cement scratch coat over metal lath on wall surfaces.
4. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
5. Section 092900 "Gypsum Board" for **[cementitious backer units] [glass-mat, water-resistant backer board]**.
6. Section 096340 "Stone Flooring" for stone paving and flooring other than dimension stone tile.
7. Section 097516 "Stone Base" for stone base in the form of running trim rather than tile.

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

### 1.3 DEFINITIONS

- A. Dimension Stone Tile: Modular stone units less than **3/4 inch (19 mm)** thick.
- B. Module Size: Actual tile size plus joint width.
- C. Polished Finish: Smooth surface that produces sharp, mirrorlike reflections. Reflected images of overhead fluorescent tubes have straight lines without visible distortion when viewed at arm's length.
- D. Honed Finish: Smooth, nonreflective surface similar to that produced by grinding with a 400- to 1200-grit abrasive; with a gap not exceeding **0.005 inch (0.13 mm)** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- E. Sand-Rubbed Finish: Uniform, fine-textured surface similar to that produced by grinding with a 40-grit abrasive; with a gap not exceeding **1/32 inch (0.8 mm)** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- F. Thermal Finish: Uniform, coarse-textured surface produced by thermal shock; with a gap not exceeding [**3/16 inch (5 mm)**] **<Insert gap>** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- G. Natural-Cleft Finish: Uneven surface produced by splitting stone along a natural cleavage plane; without visible tool marks and with a gap not exceeding [**3/16 inch (5 mm)**] **<Insert gap>** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
  - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
    - a. Include statement indicating location and distance from manufacturer to Project for each regionally manufactured material.
    - b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally

extracted and manufactured materials and fraction by weight of each regionally manufactured material that is regionally extracted.

3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
  4. Product Data for Credit IEQ 4.3: For **[adhesives] [and] [grouts]**, documentation including printed statement of VOC content.
  5. Product Data for Credit IEQ 4.3: For stone tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  6. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [stone tile flooring systems]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show locations of each type of stone tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in substrates and finished stone tile surfaces. **[ Show stone thresholds.]**
- D. Samples for Initial Selection: For each type of grout indicated and accessories involving color selection.
- E. Samples for Verification:
1. Full-size units of each type of stone tile **[ in each finish required]**.
  2. Assembled Samples with grouted joints for each type of stone tile **[ and for each finish required]**, at least **[36 inches (900 mm) square]** **<Insert size>** and mounted on a rigid panel. Use grout of type and in color(s) approved for completed Work.
  3. Range Samples consisting of at least **[two] [three] [four] [five]** **<Insert number>** full-size units of each type of stone tile, exhibiting extremes of the full range of color and other visual characteristics expected. Range Samples establish the standard by which individual stone tiles **[ and thresholds]** will be judged.
  4. Stone thresholds in **6-inch (150-mm)** lengths.
  5. Metal edge strips in **6-inch (150-mm)** lengths.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For dimension stone tile to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Dimension Stone Tile: **[Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.]**
    - a. **<Insert, in separate subparagraphs, stone tile-type designation or description and quantity required for each category of stone tile for which extra material is required>.**
  2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

## 1.8 QUALITY ASSURANCE

- A. Supplier Qualifications: A firm experienced in supplying products similar to those indicated for the Project and with a record of successful in-service performance.
- B. Source Limitations for Stone Tile[ **and Thresholds**]: Obtain each stone product type through single source from single producer.
1. For each stone product type, provide one stone variety.
  2. Where two or more stone product types are identical except for size or finish, provide same variety for each type.
  3. Where threshold types are identical to stone tile types except for size or finish, provide same variety.
  4. Obtain each variety of stone from same location in a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Waterproof membrane.
  2. Crack isolation membrane.
  3. Joint sealants.
  4. Cementitious backer units.
  5. Metal edge strips.
- E. Installer Qualifications: A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.

- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of[ **each type of**] stone floor tile installation.
  - 2. Build mockup of[ **each type of**] stone wall tile installation.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  
- G. Dry-Laid Mockups: Lay out tiles in dry-laid mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Lay out mockup of[ **each type of**] stone floor tile installation.
  - 2. Lay out mockup of[ **each type of**] stone wall tile installation.
  - 3. Maintain dry-laid mockups in an undisturbed condition until equivalent areas of the completed Work are approved to serve as mockups.
  
- H. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
  
- B. Store stone tile and cementitious materials on elevated platforms, under cover, and in a dry location.
  
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
  
- D. Store liquid materials in unopened containers and protected from freezing.

#### 1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install stone tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.11 SEQUENCING AND SCHEDULING

- A. Sequence stone tile installation with other work to minimize possibility of damage and soiling during remainder of construction period.
  
- B. Install stone tile and accessories only after other finishing operations, including painting, have been completed.



## 1.12 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 STONE PRODUCTS

- A. Varieties and Sources: Subject to compliance with requirements, **[provide those indicated] [provide one of those indicated] [stone products that may be incorporated into the Work include, but are not limited to, those indicated]**.
- B. Regional Materials: Provide stone tiles[ **and thresholds**] that have been manufactured within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regionally Manufactured Materials: Provide stone tiles[ **and thresholds**] that have been manufactured within **500 miles (800 km)** of Project site.
- D. Regionally Extracted and Manufactured Materials: Provide stone tiles[ **and thresholds**] that have been manufactured within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- E. FloorScore Compliance: Stone tile for floors shall comply with requirements of FloorScore Standard.
- F. Low-Emitting Materials: Stone tile flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than **[8] [10] [12] [25] <Insert value>**, as determined per ASTM C 1353 or ASTM C 241.
- H. Static Coefficient of Friction of Stone Tile for Floors: Provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum **<Insert required static coefficient of friction>**.
  2. Step Treads: Minimum **<Insert required static coefficient of friction>**.
  3. Ramp Surfaces: Minimum **<Insert required static coefficient of friction>**.
- I. Provide stone products that are free of defects impairing their function for use indicated, including cracks, seams, and starts.

- J. Pattern Orientation: For stone varieties with a directional pattern, provide tile with pattern **[oriented parallel to one side of tile] [randomly oriented at various angles to sides of tiles]**.
1. For stone varieties that exhibit a directional pattern, provide thresholds with pattern **[oriented parallel to] [oriented at an angle of 45 degrees or less to] [randomly oriented at various angles to]** long edges of thresholds.
- K. Stone Tile Type[ **ST-<#>**]:
1. Stone Type: Granite, complying with ASTM C 615.
  2. Stone Type: Limestone, complying with ASTM C 568, Classification **[II (Medium Density)] [III (High Density)]**.
  3. Stone Type: Marble, complying with ASTM C 503, Classification **[I, Calcite] [II, Dolomite]**.
  4. Stone Type: Quartz-based stone, complying with ASTM C 616, Classification **[II, Quartzitic Sandstone] [III, Quartzite]**.
  5. Stone Type: Serpentine, complying with ASTM C 1526, Classification **[I, Exterior] [II, Interior]**.
  6. Stone Type: Slate, complying with ASTM C 629, Classification **[I, Exterior] [II, Interior]**.
  7. Stone Type: Travertine, complying with ASTM C 1527, Classification **[I, Exterior] [II, Interior]**.
  8. Varieties and Sources:
    - a. **<Insert name of variety and producer, distributor, or importer>**.
  9. Cut: **[Vein] [Fleuri]**.
  10. Finish: **[Polished] [Honed] [Sand rubbed] [Thermal] [Natural cleft] [As indicated] [Match DEN Project Manager's sample]**.
  11. Edges: **[Square] [Beveled] [Eased]**.
  12. Module Size: **[6 by 6 inches (152 by 152 mm)] [6 by 12 inches (152 by 305)] [12 by 12 inches (305 by 305 mm)] [300 by 300 mm] [18 by 18 inches (457 by 457 mm)] [500 by 500 mm] [As indicated]**.
  13. Nominal Tile Thickness: **[1/4 inch (6 mm)] [3/8 inch (10 mm)] [1/2 inch (13 mm)] [5/8 inch (16 mm)]**.
  14. Joint Width: **[Hand tight] [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [1/4 inch (6 mm)] [3/8 inch (10 mm)] [1/2 inch (13 mm)]**.
- L. Stone Threshold Type[ **TH-<#>**]:
1. Stone Type: Granite, complying with ASTM C 615.
  2. Stone Type: Limestone, complying with ASTM C 568, Classification **[II (Medium Density)] [III (High Density)]**.
  3. Stone Type: Marble, complying with ASTM C 503, Classification **[I, Calcite] [II, Dolomite]**.
  4. Stone Type: Quartz-based stone, complying with ASTM C 616, Classification **[II, Quartzitic Sandstone] [III, Quartzite]**.
  5. Stone Type: Serpentine, complying with ASTM C 1526, Classification **[I, Exterior] [II, Interior]**.

6. Stone Type: Slate, complying with ASTM C 629, Classification [**I, Exterior**] [**II, Interior**].
7. Stone Type: Travertine, complying with ASTM C 1527, Classification [**I, Exterior**] [**II, Interior**].
8. Varieties and Sources:
  - a. <Insert name of variety and producer, distributor, or importer>.
9. Cut: [**Vein**] [**Fleuri**].
10. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Thermal**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**].
11. Edges: [**Square**] [**Beveled**] [**Eased**] [**As indicated**].
12. Nominal Threshold Thickness: [**1/4 inch** (6 mm)] [**3/8 inch** (10 mm)] [**1/2 inch** (13 mm)] [**5/8 inch** (16 mm)] [**3/4 inch** (19 mm)].

## 2.2 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; C-Cure Board 990.
    - b. Custom Building Products; Wonderboard.
    - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    - d. USG Corporation; DUROCK Cement Board.
    - e. <Insert manufacturer's name; product name or designation>.
    - f. or approved equal.
  2. Thickness: [**1/4 inch** (6.4 mm)] [**1/2 inch** (12.7 mm)] [**5/8 inch** (15.9 mm)] [**As indicated**].
- B. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FiberCement [Underlayment] [BackerBoard].
    - b. James Hardie; [Hardiebacker] [Hardiebacker 500].
    - c. <Insert manufacturer's name; product name or designation>.
    - d. or approved equal.
  2. Thickness: [**1/4 inch** (6.4 mm)] [**1/2 inch** (12.7 mm)] [**As indicated**].

## 2.3 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.10 and is recommended by the manufacturer for the

application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch** (0.76-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
    - Noble Company (The);** Nobleseal TS.
    - <Insert manufacturer's name; product name or designation>.**
    - or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch** (1.01-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
    - Compotite Corporation;** Composeal Gold.
    - <Insert manufacturer's name; product name or designation>.**
    - or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch** (0.203-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
    - Schluter Systems L.P.;** KERDI.
    - <Insert manufacturer's name; product name or designation>.**
    - or approved equal.
- E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; **0.040-inch** (1.01-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
    - National Applied Construction Products, Inc.;** Strataflex.
    - <Insert manufacturer's name; product name or designation>.**
    - or approved equal.
- F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
- Products:** Subject to compliance with requirements, provide one of the following:
    - Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.**
    - Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.**
    - Bostik, Inc.; Hydroment Blacktop 90210.**

- d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
  - e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
  - f. MAPEI Corporation; [Mapelastic L (PRP M19)] [Mapelastic HPG with MAPEI Fiberglass Mesh].
  - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
  - h. Summitville Tiles, Inc.; S-9000.
  - i. **<Insert manufacturer's name; product name or designation>.**
  - j. or approved equal.
- G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products, a QEP company; Elastiment 644 Membrane Waterproofing System.
    - b. Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane.
    - c. Bostik, Inc.; [Durabond D-222 Duraguard Membrane] [Hydroment Gold].
    - d. C-Cure; Pro-Red Waterproofing Membrane 63.
    - e. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
    - f. Jamo Inc.; Waterproof.
    - g. Laticrete International, Inc.; [Latapoxy 24hr HydroProofing] [Laticrete Watertight Floor N' Wall Waterproofing].
    - h. MAPEI Corporation; Mapelastic HPG.
    - i. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
    - j. TEC, a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
    - k. **<Insert manufacturer's name; product name or designation>.**
    - l. or approved equal.
- H. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products, a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.
    - b. C-Cure; UltraCure 971.
    - c. MAPEI Corporation; Mapelastic (PRP 315).
    - d. Southern Grouts & Mortars, Inc.; Southcrete 1100.
    - e. TEC, a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
    - f. **<Insert manufacturer's name; product name or designation>.**
    - g. or approved equal.
- I. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)],[, that complies with the testing and product

requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,") in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. **Bostik, Inc.;** [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
  - b. <Insert manufacturer's name; product name or designation>.
  - c. or approved equal.

## 2.4 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.12 for [**standard**] [**high**] performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch** (0.76-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. **Noble Company (The);** Nobleseal CIS.
  - b. <Insert manufacturer's name; product name or designation>.
  - c. or approved equal.

C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch** (1.01-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. **Compotite Corporation;** Composeal Gold.
  - b. <Insert manufacturer's name; product name or designation>.
  - c. or approved equal.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch** (0.203-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. **Schluter Systems L.P.;** KERDI.
  - b. <Insert manufacturer's name; product name or designation>.
  - c. or approved equal.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; **1/8-inch** (3-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. Schluter Systems L.P.; DITRA.
  - b. **<Insert manufacturer's name; product name or designation>**.
  - c. or approved equal.
  
- F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. MAPEI Corporation; Mapelastic SM.
    - b. National Applied Construction Products, Inc.; Strataflex.
    - c. **<Insert manufacturer's name; product name or designation>**.
    - d. or approved equal.
  
- G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
    - b. Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
    - c. Bostik, Inc.; Hydroment Blacktop 90210.
    - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - e. Laticrete International, Inc.; Laticrete [**Blue 92 Anti-Fracture Membrane**] [**9235 Waterproof Membrane**].
    - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
    - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
    - h. Summitville Tiles, Inc.; S-9000.
    - i. **<Insert manufacturer's name; product name or designation>**.
    - j. or approved equal.
  
- H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
    - b. C-Cure; [**CureLastic 949**] [**Pro-Red Waterproofing Membrane 963**].
    - c. Custom Building Products; [**Redgard Waterproofing and Crack Prevention Membrane**] [**FractureFree Crack Prevention Membrane**] [**Semco Crack Prevention Membrane**].
    - d. Jamo Inc.; Waterproof.
    - e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
    - f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.

- g. TEC, a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
  - h. **<Insert manufacturer's name; product name or designation>.**
  - i. or approved equal.
- I. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; UltraCure 971.
    - b. MAPEI Corporation; Mapelastic (PRP 315).
    - c. TEC, a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
    - d. **<Insert manufacturer's name; product name or designation>.**
    - e. or approved equal.
- J. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a **VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**,][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
    - b. **<Insert manufacturer's name; product name or designation>.**
    - c. or approved equal.

## 2.5 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
  1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, **4.0 mils** (0.1 mm) thick.
  2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, **2 by 2 inches** (50.8 by 50.8 mm) by **0.062 inch** (1.57 mm) in diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M except for minimum wire size.
  3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.
    - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
    - b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.



- c. Configuration over Studs and Furring: Flat.
    - d. Configuration over Solid Surfaces: Self furring.
    - e. Weight: [2.5 lb/sq. yd. (1.4 kg/sq. m)] [3.4 lb/sq. yd. (1.8 kg/sq. m)].
  4. Latex Additive: **[Manufacturer's standard] [acrylic resin] [or] [styrene-butadiene-rubber]** water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.
- B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Boiardi Products; a QEP company.](#)
    - b. [Bonsal American; an Oldcastle company.](#)
    - c. [Bostik, Inc.](#)
    - d. [C-Cure.](#)
    - e. [Custom Building Products.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)
    - i. [Southern Grouts & Mortars, Inc.](#)
    - j. [Summitville Tiles, Inc.](#)
    - k. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - l. **<Insert manufacturer's name>.**
    - m. or approved equal.
  2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Boiardi Products; a QEP company.](#)
    - b. [Bonsal American; an Oldcastle company.](#)
    - c. [Bostik, Inc.](#)
    - d. [C-Cure.](#)
    - e. [Custom Building Products.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)
    - i. [Mer-Kote Products, Inc.](#)
    - j. [Southern Grouts & Mortars, Inc.](#)
    - k. [Summitville Tiles, Inc.](#)
    - l. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - m. **<Insert manufacturer's name>.**

- n. or approved equal.
  2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  3. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.
  4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- D. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of [5/8 inch (16 mm)] <Insert thickness>.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Bonsal American; an Oldcastle company.](#)
    - b. [Bostik, Inc.](#)
    - c. [C-Cure.](#)
    - d. [Custom Building Products.](#)
    - e. [Jamo Inc.](#)
    - f. [Laticrete International, Inc.](#)
    - g. [MAPEI Corporation.](#)
    - h. [Mer-Kote Products, Inc.](#)
    - i. [Southern Grouts & Mortars, Inc.](#)
    - j. [Summitville Tiles, Inc.](#)
    - k. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - l. <Insert manufacturer's name>.
    - m. or approved equal.
  2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  3. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.
- E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thin Set): ANSI A118.11.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Bonsal American; an Oldcastle company.](#)
    - b. [Bostik, Inc.](#)
    - c. [C-Cure.](#)
    - d. [Custom Building Products.](#)
    - e. [Jamo Inc.](#)
    - f. [Laticrete International, Inc.](#)
    - g. [MAPEI Corporation.](#)
    - h. [Southern Grouts & Mortars, Inc.](#)
    - i. [Summitville Tiles, Inc.](#)

- j. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - k. <Insert manufacturer's name>.
    - l. or approved equal.
  2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  3. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.
- F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3[.][, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Atlas Minerals & Chemicals, Inc.](#)
    - b. [Bonsal American; an Oldcastle company.](#)
    - c. [Bostik, Inc.](#)
    - d. [C-Cure.](#)
    - e. [Custom Building Products.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)
    - i. [Mer-Kote Products, Inc.](#)
    - j. [Southern Grouts & Mortars, Inc.](#)
    - k. [Summitville Tiles, Inc.](#)
    - l. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - m. <Insert manufacturer's name>.
    - n. or approved equal.
- G. Organic Adhesive: ANSI A136.1, Type I[.][, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Bonsal American; an Oldcastle company.](#)
    - b. [Bostik, Inc.](#)
    - c. [C-Cure.](#)
    - d. [Custom Building Products.](#)
    - e. [DAP Inc.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)

- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal

## 2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

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

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonsal American; an Oldcastle company.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal.

C. Polymer-Modified Tile Grout: ANSI A118.7.

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

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonsal American; an Oldcastle company.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
  3. Polymer Type: [**Acrylic resin**] [or] [**styrene-butadiene rubber**] in liquid-latex form for addition to prepackaged dry-grout mix.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Atlas Minerals & Chemicals, Inc.](#)
    - b. [Boiardi Products; a QEP company.](#)
    - c. [Bonsal American; an Oldcastle company.](#)
    - d. [Bostik, Inc.](#)
    - e. [C-Cure.](#)
    - f. [Custom Building Products.](#)
    - g. [Jamo Inc.](#)
    - h. [Laticrete International, Inc.](#)
    - i. [MAPEI Corporation.](#)
    - j. [Mer-Kote Products, Inc.](#)
    - k. [Southern Grouts & Mortars, Inc.](#)
    - l. [Summitville Tiles, Inc.](#)
    - m. [TEC; a subsidiary of H. B. Fuller Company.](#)
    - n. **<Insert manufacturer's name>**.
    - o. or approved equal.

## 2.7 ELASTOMERIC SEALANTS

- A. Sealants shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D.
- B. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- D. Colors: Provide colors of exposed sealants to match colors of grout in stone tile adjoining sealed joints unless otherwise indicated.
- E. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior stone tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
  1. **Products**: Subject to compliance with requirements, provide one of the following:

- a. [DAP Inc.](#); [Titanium Enriched Kitchen and Bath Sealant] [100 percent Silicone Kitchen and Bath Sealant].
  - b. [Dow Corning Corporation](#); [Dow Corning 786](#).
  - c. [GE Silicones, a division of GE Specialty Materials](#); [Sanitary 1700](#).
  - d. [Laticrete International, Inc.](#); [Latasil Tile & Stone Sealant](#).
  - e. [Pecora Corporation](#); [Pecora 898 Sanitary Silicone Sealant](#).
  - f. [Tremco Incorporated](#); [Tremsil 600 White](#).
  - g. <Insert manufacturer's name; product name or designation>.
  - h. or approved equal.
- F. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. [Bostik, Inc.](#); [Chem-Calk 550](#).
    - b. [Degussa Building Systems](#); [Sonneborn Sonolastic SL 2](#).
    - c. [Pecora Corporation](#); [Dynatrol II-SG] [NR-200 Urexpan].
    - d. [Sika Corporation](#); [Sikaflex-2c SL](#).
    - e. [Tremco Incorporated](#); [THC-900] [THC-901] [Vulkem 245].
    - f. <Insert manufacturer's name; product name or designation>.
    - g. or approved equal.

## 2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match stone tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; [half-hard brass] [white zinc alloy] [nickel silver] [stainless-steel, ASTM A 666, 300 Series] exposed-edge material.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Blanke Corporation](#).
    - b. [Ceramic Tool Company, Inc.](#)
    - c. [Schluter Systems L.P.](#)
    - d. <Insert manufacturer's name>.
    - e. or approved equal.
- C. Protective Coating: Liquid grout-release coating that is formulated to protect exposed surfaces of stone tile against adherence of mortar and grout; compatible with stone, mortar, and grout products; easily removable after grouting is completed without damaging grout or stone tile; and recommended for use as temporary protective coating for stone tile.

1. Floor sealer complying with "Floor Sealer" Paragraph below may be used provided it is recommended by manufacturer for use as a grout release.
- D. Cleaner: A neutral cleaner capable of removing soil and residue without harming stone tile and grout surfaces, specifically approved for materials and installations indicated by stone tile producers and grout manufacturers.
- E. Floor Sealer: Colorless, stain- and slip-resistant sealer, not affecting color or physical properties of stone surfaces as recommended by stone tile producers for application indicated.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Bostik, Inc.](#)
    - b. [Custom Building Products.](#)
    - c. [Hillyard, Inc.](#)
    - d. [HMK Stone Care System.](#)
    - e. [Summitville Tiles, Inc.](#)
    - f. **<Insert manufacturer's name>**.
    - g. or approved equal.

## 2.9 FABRICATION

- A. Facial Dimensions of Stone Tiles with [**Polished**] [**or**] [**Honed**] Faces: Do not vary facial dimensions from specified dimensions by more than plus or minus **1/64 inch** (0.4 mm).
- B. Facial Dimensions of Stone Tiles with [**Sand-Rubbed**] [**Natural-Cleft**] [**or**] [**Thermal-Finished**] Faces: Do not vary facial dimensions from specified dimensions by more than plus or minus **1/32 inch** (0.8 mm).
- C. Thickness of Stone Tiles with [**Polished**] [**Honed**] [**or**] [**Sand-Rubbed**] Finish: Do not vary from specified thickness by more than plus or minus **1/32 inch** (0.8 mm).
- D. Thickness of Stone Tiles with [**Natural-Cleft**] [**or**] [**Thermal**] Finish: Do not vary average thickness of each stone tile from specified thickness by more than plus or minus [**1/32 inch** (0.8 mm)] [**1/16 inch** (1.6 mm)].
- E. Joint Surfaces: Except for specified beveled or eased edges if any, dress joint surfaces square for full depth of stone tile.
- F. Backs of Pieces: Gage units by dressing backs of pieces smooth and flat. When tested with a **24-inch** (600-mm) straightedge, gap shall not exceed **1/32 inch** (0.8 mm).
  1. Natural-cleft stone need not be gaged if gap does not exceed **1/16 inch** (1.6 mm) when tested with a **24-inch** (600-mm) straightedge on backs of units.
- G. Thresholds: Fabricate to size and profile as indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges of thresholds at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to **1/2 inch (13 mm)** or less, and finish bevel to match face of threshold.

## 2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and with mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where stone tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed stone tile.
  1. Verify that substrates for setting stone tile are firm, dry, clean, and free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone, and that they comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. Verify that concrete substrates for stone tile floors installed with **[adhesives]** **[bonded mortar bed]** **[or]** **[thin-set mortar]** comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind stone tile has been completed.
  4. Verify that joints and cracks in stone tile substrates are coordinated with stone tile joint locations; if not coordinated, adjust joint locations in consultation with DEN Project Manager.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for stone tile floors installed with **[adhesives]** **[or]** **[thin-set mortar]** with trowelable patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- C. Lay out stone tile patterns by marking joint lines on substrates to verify joint placement at edges, corners, doors, and other critical elements.
  - 1. Notify DEN Project Manager seven days in advance of dates and times when layout will be done.
  - 2. Obtain DEN Project Manager's approval of layout before starting stone tile installation.
- D. Lay out stone tiles on substrates or on an adjacent surface to establish placement of individual stone tiles for balance of color and pattern variations.
  - 1. Notify DEN Project Manager seven days in advance of dates and times when layout will be done.
  - 2. DEN Project Manager may relocate specific stone tiles with other stone tiles of same type and will determine final location of each stone tile within indicated patterns.
  - 3. Identify each stone tile with a temporary number marked on face of stone tile that corresponds with an identical number marked on a layout drawing, and obtain DEN Project Manager's approval before starting stone tile installation.
- E. Field-Applied Temporary Protective Coating: If indicated under stone tile type or needed to prevent grout from staining or adhering to exposed stone tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed stone tile surfaces.

### 3.3 STONE TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in stone tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods specified in stone tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
    - a. Exterior stone tile floors.
    - b. Stone tile floors in wet areas.

- c. Stone tile floors composed of stone tiles **8 by 8 inches** (200 by 200 mm) or larger.
- B. Wipe backs of stone tiles with a damp cloth to remove dirt and dust before units are installed.
- C. Extend stone tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of stone tile without marring visible surfaces. Carefully grind cut edges of stone tile abutting trim, finish, or built-in items for straight aligned joints. Fit stone tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap stone tile.
- E. Finish cut stone tile edges that will not be concealed by other construction by grinding and honing cut surfaces [**and beveling edges**] [**and easing edges**] to match factory-fabricated edges[ **unless otherwise indicated**].
- F. Jointing Pattern: Lay stone tile in grid pattern unless otherwise indicated. Lay out stone tile work and center stone tile fields in both directions in each space or on each wall area. Lay out stone tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. Where adjoining stone tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
- G. Lay out stone tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Match stone tiles within each space by selecting tiles to achieve uniformity of color and pattern. Reject or relocate stone tiles that do not match color and pattern of adjacent tiles.
- I. Mix stone tiles to achieve a uniformly random distribution of color shadings and patterns.
- J. Pattern Orientation: For stone varieties with directional pattern, orient pattern as [**indicated**] [**directed by DEN Project Manager**].
- K. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and stone tile. Do not saw-cut joints after installing stone tiles.
  - 1. Where joints occur in concrete substrates, locate joints in stone tile surfaces directly above them.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- L. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
  2. Do not extend **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** under thresholds set in **[dry-set Portland cement] [or] [latex-Portland cement]** mortar. Fill joints between such thresholds and adjoining stone tile set on **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** with elastomeric sealant.
- M. Metal Edge Strips: Install **[at locations indicated] [where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with top of stone tile] [where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of stone tile and no threshold is indicated].**
- 3.4 TILE BACKING PANEL INSTALLATION
- A. Install **[cementitious backer units] [or] [fiber-cement underlayment]** at **[showers] [tubs]** and where indicated.
  - B. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.**[ Use latex-Portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.]**
- 3.5 WATERPROOFING INSTALLATION
- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
  - B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- 3.6 CRACK ISOLATION MEMBRANE INSTALLATION
- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
  - B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.7 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical joints, external corners, and other conspicuous lines, do not exceed **1/8 inch in 8 feet** (3 mm in 2.4 m).
- B. Variation in Level: For horizontal joints and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), or **1/2 inch** (12 mm) maximum.
- C. Variation in Surface Plane of Flooring: Do not exceed **1/8 inch in 10 feet** (3 mm in 3 m) from level or slope indicated when tested with a **10-foot** (3-m) straightedge.
- D. Variation in Plane between Adjacent Units (Lipping): Do not exceed the following differences between faces of adjacent units as measured from a straightedge parallel to stone tiled surface:
  - 1. Units with Polished Faces: **1/64 inch** (0.4 mm).
  - 2. Units with Honed Faces: [**1/64 inch** (0.4 mm)] [**1/32 inch** (0.8 mm)].
  - 3. Units with Sand-Rubbed Faces: **1/32 inch** (0.8 mm).
  - 4. Units with Thermal-Finished Faces: Depth of thermal finish or **3/16 inch** (5 mm), whichever is less.
  - 5. Units with Natural-Cleft Faces: Depth of natural-cleft finish or **3/16 inch** (5 mm), whichever is less.
- E. Variation in Joint Width: Do not vary joint thickness more than **1/16 inch** (1.6 mm) or one-fourth of nominal joint width, whichever is less.
- F. Hand-Tight Joints: Do not exceed [**1/64 inch** (0.4 mm)] [**1/32 inch** (0.8 mm)].

### 3.8 ADJUSTING AND CLEANING

- A. Remove and replace material that is stained or otherwise damaged or that does not match adjoining stone tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean stone tile surfaces so they are free of foreign matter.
  - 1. Remove [**epoxy**] [**and**] [**latex-Portland cement**] grout residue from stone tile as soon as possible.
  - 2. Clean grout smears and haze from stone tile according to stone tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by stone tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of stone tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  - 3. Remove temporary protective coating by method recommended by coating manufacturer and acceptable to stone tile and grout manufacturer. Trap and

remove coating to prevent drain clogging.[ **Do not remove floor sealer if used as protective coating.**]

- C. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

### 3.9 PROTECTION

- A. Protect installed stone tile floors with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by stone tile manufacturer, apply coat of neutral protective cleaner to completed stone tile walls and floors.
- B. Prohibit foot and wheel traffic from stone tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from stone tile surfaces.

### 3.10 EXTERIOR STONE TILE INSTALLATION SCHEDULE

- A. Exterior Floor Installations:

- 1. Stone Tile Installation F101: Cement mortar bed (thickset) [**bonded to concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated**]; TCA F101 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- 2. Stone Tile Installation F102: Thin-set mortar [**on concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated**]; TCA F102.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.

- B. Exterior Wall Installations, Masonry or Concrete:

1. Stone Tile Installation W201: Cement mortar bed (thickset) on metal lath over waterproof membrane; TCA W201 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat for Wet-Set Method: **[Dry-set]** **[Latex-]** Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** Portland cement mortar.
  - d. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.
  
2. Stone Tile Installation W202: Thin-set mortar; TCA W202.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

### 3.11 INTERIOR STONE TILE INSTALLATION SCHEDULE

#### A. Interior Floor Installations, Concrete Subfloor:

1. Stone Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.
  
2. Stone Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.
  
3. Stone Tile Installation F113: Thin-set mortar; TCA F113.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.

- b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
4. Stone Tile Installation F114: Cement mortar bed (thickset) with cleavage membrane; epoxy grout; TCA F114 and ANSI A108.1B.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: Water-cleanable epoxy grout.
5. Stone Tile Installation F116: **[Organic adhesive] [Water-cleanable, tile-setting epoxy]**; TCA F116.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
6. Stone Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
7. Stone Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: Polymer-modified **[sanded] [unsanded]** grout.
8. Stone Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
  - a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
9. Stone Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Grout: Water-cleanable epoxy grout.
  10. Stone Tile Installation F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed [**bonded to concrete subfloor**] [**installed over cleavage membrane**]; epoxy grout; TCA F132.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Grout: Water-cleanable epoxy grout.
- B. Interior Floor Installations, Wood Subfloor:
1. Stone Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  2. Stone Tile Installation F141: Cement mortar bed (thickset) with cleavage membrane; TCA F141 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
    - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  3. Stone Tile Installation F142: Organic adhesive; TCA F142.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  4. Stone Tile Installation F143: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F143.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Grout: Water-cleanable epoxy grout.
  5. Stone Tile Installation F144: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA F144.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.



- c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  6. Stone Tile Installation F150/160: Thin-set mortar on exterior-glue plywood; TCA F150 or TCA F160.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- C. Interior Radiant-Heat Floor Installations, Concrete Subfloor:
1. Stone Tile Installation RH110: Thin-set mortar on crack isolation membrane; hydronic piping installed in concrete; TCA RH110.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  2. Stone Tile Installation RH115: Thin-set mortar; electric radiant-heat system encapsulated in thin-set mortar; TCA RH115.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  3. Stone Tile Installation RH116: Thin-set mortar on crack isolation membrane; electric radiant-heat system encapsulated in cementitious self-leveling underlayment; TCA RH116.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    - c. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
    - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- D. Interior Radiant-Heat Floor Installations, Wood Subfloor:
1. Stone Tile Installation RH130: Thin-set mortar on exterior-glue plywood; electric radiant-heat system encapsulated in thin-set mortar; TCA RH130.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
2. Stone Tile Installation RH135: Thin-set mortar on cementitious backer units or fiber-cement underlayment; electric radiant-heat system encapsulated in thin-set mortar; TCA RH135.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
3. Stone Tile Installation RH140: Thin-set mortar on crack isolation membrane; electric radiant-heat system encapsulated in cementitious self-leveling underlayment; TCA RH140.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
  - c. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
  - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- E. Interior Wall Installations, Masonry or Concrete:
1. Stone Tile Installation W202: Thin-set mortar; TCA W202.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  2. Stone Tile Installation W211: Cement mortar bed (thickset) bonded to substrate; TCA W211 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.

3. Stone Tile Installation W221: Cement mortar bed (thickset) on metal lath[ **over waterproof membrane**]; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: <**Insert stone tile-type designation**>.
    - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  
  4. Stone Tile Installation W222: One-coat cement mortar bed (thickset) on metal lath[ **over waterproof membrane**]; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: <**Insert stone tile-type designation**>.
    - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
  
  5. Stone Tile Installation W223: Organic adhesive; TCA W223.
    - a. Stone Tile Type: <**Insert stone tile-type designation**>.
    - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- F. Interior Wall Installations, Wood Studs or Furring:
1. Stone Tile Installation W221: Cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: <**Insert stone tile-type designation**>.
    - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
    - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
  
  2. Stone Tile Installation W222: One-coat cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
    - a. Stone Tile Type: <**Insert stone tile-type designation**>.

- b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Stone Tile Installation W223: Organic adhesive on solid backing; TCA W223.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Stone Tile Installation W231: Cement mortar bed (thickset); TCA W231 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
5. Stone Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
6. Stone Tile Installation W244: Thin-set mortar on cementitious backer units or fiber-cement underlayment[ **over cleavage membrane**]; TCA W244.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
7. Stone Tile Installation W245: [**Thin-set mortar**] [**Organic adhesive**] on coated glass-mat, water-resistant gypsum backer board; TCA W245.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.

G. Interior Wall Installations, Metal Studs or Furring:

1. Stone Tile Installation W221: Cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
2. Stone Tile Installation W222: One-coat cement mortar bed (thickset)[ **over waterproof membrane**] on solid backing; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Stone Tile Installation W223: Organic adhesive on solid backing; TCA W223.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Stone Tile Installation W241: Cement mortar bed (thickset); TCA W241 and ANSI A108.1B.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
  - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
5. Stone Tile Installation W242: Organic adhesive on gypsum board; TCA W242.
  - a. Stone Tile Type: <**Insert stone tile-type designation**>.
  - b. Grout: [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
6. Stone Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
7. Stone Tile Installation W244: Thin-set mortar on cementitious backer units or fiber-cement underlayment[ **over cleavage membrane**]; TCA W244.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
8. Stone Tile Installation W245: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant gypsum backer board; TCA W245.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- H. Bathtub Wall Installations, **[Wood] [Metal]** Studs or Furring:
1. Stone Tile Installation B413: **[Thin-set mortar] [Organic adhesive]** on water-resistant gypsum board; TCA B413.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- I. Bathtub/Shower Wall Installations, **[Wood] [Metal]** Studs or Furring:
1. Stone Tile Installation B411: Cement mortar bed (thickset); TCA B411 and ANSI A108.1A.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
  2. Stone Tile Installation B412: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA B412.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.

- b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
  3. Stone Tile Installation B419: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant backer board; TCA B419.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- J. Shower Receptor and Wall Installations, Concrete or Masonry:
  1. Stone Tile Installation B414: Cement mortar bed (thickset); TCA B414 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
    - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
  2. Stone Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: Latex-Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
  3. Stone Tile Installation B422: Thin-set mortar on waterproof membrane with integrated bonding flange for bonded membranes; TCA B422.
    - a. Stone Tile Type: **<Insert stone tile-type designation>**.
    - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
    - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- K. Shower Receptor and Wall Installations, **[Wood] [Metal]** Studs or Furring:
  1. Stone Tile Installation B414: Cement mortar bed (thickset); TCA B414 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
  - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
2. Stone Tile Installation B415: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA B415.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
3. Stone Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
4. Stone Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber-cement underlayment; TCA B421.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: Latex-Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
5. Stone Tile Installation B422: Thin-set mortar on waterproof membrane over cementitious backer units or fiber-cement underlayment with integrated bonding flange for bonded membranes; TCA B422.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
  - b. Thin-Set Mortar: Latex-Portland cement mortar.
  - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.



#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 093033

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Requirements:
  - 1. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
  - 2. Section 095133 "Acoustical Metal Pan Ceilings."
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
  3. Laboratory Test Reports for Credit EQ 4: For **[ceiling systems] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each exposed product and for each color and texture specified, **6 inches** (150 mm) in size.
- D. Samples for Initial Selection: For components with factory-applied color finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
1. Acoustical Panel: Set of **[full-size] [6-inch- (150-mm-) square]** Samples of each type, color, pattern, and texture.
  2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-) long** Samples of each type, finish, and color.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
  2. Structural members to which suspension systems will be attached.
  3. Size and location of initial access modules for acoustical panels.
  4. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Fire alarm system devices.
    - g. Security devices.
    - h. **<Insert item>**.
  5. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.

- D. Evaluation Reports: For each acoustical panel ceiling suspension system[ **and anchor and fastener type**], from ICC-ES.
- E. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full-size panels equal to [2] <Insert number> percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to [2] <Insert number> percent of quantity installed.
  - 3. Hold-Down Clips: Equal to [2] <Insert number> percent of quantity installed.
  - 4. Impact Clips: Equal to [2] <Insert number> percent of quantity installed.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.
- B. CONSTRUCTION WASTE MANAGEMENT
- C. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for [Class A] materials.
  - 2. Smoke-Developed Index: [50] <Insert value> or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

#### 2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  2. Suspension System: Obtain each type from single source from single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- D. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- E. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- F. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches** (400 mm) away from test surface according to ASTM E 795.
- G. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by DEN Project Manager from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- H. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.
- 2.3 ACOUSTICAL PANELS **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.
  3. Chicago Metallic Corporation.
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
  5. **<Insert manufacturer's name>**
  6. or approved equal.
- B. Classification: Provide **[ fire-resistance-rated ]** panels complying with ASTM E 1264 for

type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; [**Form 1, nodular**] [**Form 2, water felted**] [**Form 4, cast or molded**].
  2. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with [**glass-fiber cloth**] [**washable vinyl-film**] overlay.
  3. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with [**vinyl overlay on face**] [**vinyl overlay on face and back**] [**vinyl overlay on face, back, and sealed edges**] [**fiberglass-fabric overlay on face**].
  4. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; [**Form 1, plastic**] [**Form 2, cloth**] [**Form 3, other**].
  5. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
  6. Type and Form: <Insert type and form>.
  7. Pattern: [**C (perforated, small holes)**] [**CD (perforated, small holes and fissured)**] [**CE (perforated, small holes and lightly textured)**] [**D (fissured)**] [**E (lightly textured)**] [**F (heavily textured)**] [**G (smooth)**] [**GH (smooth and printed)**] [**I (embossed)**] [**J (embossed-in-register)**] [**K (surface scored)**] [**Z (other patterns as described)**] [**As indicated by manufacturer's designation**] <Insert pattern>.
- C. Color: [**White**] [**As selected from manufacturer's full range**] [**Match DEN Project Manager's sample**] [**As indicated by manufacturer's designation**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert color>.
- D. LR: Not less than [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] <Insert LR>.
- E. NRC: Not less than [**0.10**] [**0.35**] [**0.40**] [**0.50**] [**0.55**] [**0.60**] [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] [**0.95**] [**1.00**] <Insert NRC>.
- F. CAC: Not less than [**20**] [**25**] [**30**] [**35**] [**40**] <Insert CAC>.
- G. AC: Not less than [**170**] [**180**] [**190**] [**200**] [**210**] <Insert AC>.
- H. Edge/Joint Detail: [**Square**] [**Reveal sized to fit flange of exposed suspension-system members**] [**Flush reveal sized to fit flange of exposed suspension-system members**] [**Beveled, kerfed and rabbeted long edges and square, butt-on short edges**] <Insert manufacturer's special proprietary edge detail>.
- I. Thickness: [**5/8 inch (15 mm)**] [**3/4 inch (19 mm)**] [**7/8 inch (22 mm)**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert thickness>.
- J. Thickness: [**1/8 inch (3 mm)**] [**7/16 inch (12 mm)**] [**9/16 inch (15 mm)**] [**5/8 inch (15 mm)**] [**3/4 inch (19 mm)**] [**7/8 inch (22 mm)**] [**1 inch (25 mm)**] [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**3 inches (76 mm)**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert dimension>.

- K. Modular Size: [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [600 by 600 mm] [600 by 1200 mm] [As indicated on Drawings] [As indicated in a schedule] <Insert size>.
- L. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to [five] <Insert safety factor> times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: [Cast-in-place] [Postinstalled expansion] [Postinstalled bonded] anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
  - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to [10] <Insert safety factor> times that imposed by ceiling construction, as determined by testing according to



ASTM E 1190, conducted by a qualified testing and inspecting agency.

- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
  4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than [0.106-inch- (2.69-mm-)] [0.135-inch- (3.5-mm-)] **<Insert dimension>** diameter wire.
- E. **[Hanger Rods] [Flat Hangers]**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide; formed with **0.04-inch-** (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced **24 inches** (610 mm) o.c. on all cross tees.
- K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- L. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including **[manufacturer's standard] [closed-cell PVC] [neoprene] [antimicrobial]** gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

## 2.5 METAL SUSPENSION SYSTEM **<Insert drawing designation>**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.

3. Chicago Metallic Corporation.
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
  5. **<Insert manufacturer's name>**
  6. or approved equal.
- B. Wide-Face, Capped, Double-Web,[ **Fire-Rated**,] Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished **15/16-inch-** (24-mm-) wide metal caps on flanges.
1. Structural Classification: [**Intermediate**] [**Heavy**]-duty system.
  2. End Condition of Cross Runners: [**Override (stepped)**] [**or**] [**butt-edge**] type.
  3. Face Design: Flat, flush.
  4. Cap Material: [**Steel**] [**or**] [**aluminum**] cold-rolled sheet.
  5. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**] [**Plated with metallic finish indicated by manufacturer's designation**] [**Natural finish for aluminum**].
- C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished **9/16-inch-** (15-mm-) wide metal caps on flanges.
1. Structural Classification: [**Intermediate**] [**Heavy**]-duty system.
  2. End Condition of Cross Runners: [**Override (stepped)**] [**or**] [**butt-edge**] type.
  3. Face Design: [**Flat, flush**] [**Flanges formed with an integral center reveal**].
  4. Cap Material: [**Steel**] [**or**] [**aluminum**] cold-rolled sheet.
  5. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**] [**Plated with metallic finish indicated by manufacturer's designation**] [**Natural finish for aluminum**].
- D. Narrow-Face, Steel-Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished, cold-rolled, **9/16-inch-** (15-mm-) wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
  2. Face Design: Flat, flush.
  3. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**]

**[Plated with metallic finish indicated by manufacturer's designation]  
[Natural finish for aluminum].**

- E. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized; to produce structural members with **9/16-inch-** (15-mm-) wide faces.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
  2. Face Design: **[With 1/8-inch-** (3.2-mm-) **wide, slotted, box-shaped flange] [With 1/4-inch-** (6.35-mm-) **wide, slotted, box-shaped flange] [Flanges formed in stepped design with a center protrusion projecting 19/64 inch** (7.54 mm) **below flange surfaces supporting panel faces and forming 3/16-inch-** (4.76-mm-) **wide reveals between edges of protrusion and those of panels].**
  3. Face Finish: Painted **[white] [in color as selected from manufacturer's full range] [to match color indicated by manufacturer's designation] [to match color of acoustical unit].**
  4. Reveal Finish: Painted **[to match flange color] [white] [black] [in color other than flange color as selected from manufacturer's full range of contrasting reveal colors].**
- F. Wide-Face, Capped, Double-Web, **[ Fire-Rated,]** Hot-Dip Galvanized, **G60** (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, **G60** (Z180) coating designation; with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
  2. Face Design: Flat, flush.
  3. Face Finish: **[Painted white] [Painted to match color indicated by manufacturer's designation] [Painted to match color of acoustical unit] [Natural finish].**
- G. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
1. Structural Classification: Heavy-duty system.
  2. Face Finish: Painted **[white] [black].**
- H. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from Type 304 or 316, stainless-steel sheet, with prefinished **15/16-inch-** (24-mm-) wide stainless-steel caps on flanges.
1. Structural Classification: Intermediate-duty system.
  2. Face Design: Flat, flush.
- I. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with **9/16-inch-** (15-mm-) wide faces.

1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
  2. Face Design: Screw-slot profile.
  3. Face Finish: **[Painted white] [Satin anodized according to AAMA 611, AA-M12C22A31]**.
  4. Reveal Finish: **[Match face finish] [Painted white] [Painted black]**.
- J. Extra-Wide-Face, **[Double] [Single]**-Web, Metal Suspension System: Main and cross runners formed from **[extruded aluminum] [aluminum-capped steel] [steel-capped steel]** <Insert description> to produce structural members with **[1-1/2-inch- (38-mm-)] [2-inch- (50-mm-)]** wide flanges.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
  2. Face Design: Flat, flush.
  3. Face Finish: **[Painted white] [Satin anodized according to AAMA 611, AA-M12C22A31]**.
  4. Gasket System: Clean-room type.

## 2.6 METAL EDGE MOLDINGS AND TRIM <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.
  3. Chicago Metallic Corporation.
  4. Fry Reglet Corporation.
  5. Gordon, Inc.
  6. USG Interiors, Inc.; Subsidiary of USG Corporation.
  7. **<Insert manufacturer's name>**
  8. or approved equal.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
  2. For lay-in panels with reveal edge details, provide **[stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member] <Insert description>**.
  3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with [ASTM B 221](#) (ASTM B 221M) for Alloy and Temper 6063-T5.
2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
3. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.7 ACOUSTICAL SEALANT

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

1. Acoustical Sealant for Exposed and Concealed Joints:
  - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
  - b. USG Corporation; SHEETROCK Acoustical Sealant.
  - c. **<Insert manufacturer's name>**
  - d. or approved equal.
2. Acoustical Sealant for Concealed Joints:
  - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
  - b. Pecora Corporation; AIS-919.
  - c. Tremco, Inc.; Tremco Acoustical Sealant.
  - d. **<Insert manufacturer's name>**
  - e. or approved equal.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall [**have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**] [**comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which

acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required[ **and, if permitted with fire-resistance-rated ceilings,**] to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than **48 inches** (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches** (200 mm) from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than **16 inches** (400 mm) o.c. and not more than **3 inches** (75 mm) from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet** (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
    - b. Install panels with pattern running in one direction parallel to **[long]** **[short]** axis of space.
    - c. Install panels in a basket-weave pattern.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install [**hold-down**] [**impact**] clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: [**Owner will engage**] [**Engage**] a qualified special inspector to perform the following special inspections:
  1. Compliance of seismic design.
- B. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
  1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.



### 3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 095113

## SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes acoustical metal pans and associated suspension system for interior ceilings.
- B. Related Requirements:
  - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
  - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
  - 3. Section 095423 "Linear Metal Ceilings."
  - 4. Section 095436 "Suspended Decorative Grids."
- C. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

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

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
  2. Product Data for Credit IEQ 4.1: For sealants[ **and adhesives**], documentation including printed statement of VOC content.
  3. Laboratory Test Reports for Credit IEQ 4.1: For [**ceiling systems**] [**and sealants**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
1. Metal Pans: Set of [**full-size**] [**6-inch- (150-mm-) square**] Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
  2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-)** long Samples of each type, finish, and color.
  3. Sound Absorber: Sample of each type matching size of Sample metal pan.
- F. Delegated-Design Submittal: For design of [**seismic restraints and**] attachment devices.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
  2. Structural members to which suspension systems will be attached.
  3. Size and location of access modules for acoustical panels.
  4. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. **<Insert item>**.
  5. Perimeter moldings.

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.
- D. Evaluation Reports: For each acoustical metal pan ceiling suspension system[ **and anchor and fastener type**].
- E. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Metal Pans: Full-size units equal to **[2] <Insert number>** percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to **[2] <Insert number>** percent of quantity installed.
  - 3. Hold-Down Clips: **[Equal to 2 percent of quantity installed] <Insert number>**.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

#### 1.10 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design **[seismic restraints and ]**attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for **[Class A] [Class B] [Class C]** materials.
  - 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.

#### 2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent for metal pans and not less than **<Insert number>** percent for sound-absorbent insulation.
- C. Glass-Fiber Insulation: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches (400 mm)** away from test surface according to ASTM E 795.
- E. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Rolled aluminum sheet, complying with [ASTM B 209](#) (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
  2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.
    - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, [13Z](#) (40G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
    - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
  3. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, **[Type 304]** **[Type 430]** **<Insert type>**.
- F. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E 84.
1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.
- G. Sound-Absorbent Pads: Provide width and length to completely fill concealed surface of pan, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E 84, and to comply with the following requirements:
1. Plastic Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, Type II, or Type III, and as follows:
    - a. Mineral-Fiber Type and Thickness: Glass fiber; **[1 inch (25 mm)]** **[1-1/2 inches (38 mm)]** **[3 inches (76 mm)]** **<Insert dimension>**.
    - b. Mineral-Fiber Density: **[3/4 lb/cu. ft. (12 kg/cu. m)]** **[1 lb/cu. ft. (16 kg/cu. m)]** **[1-1/2 lb/cu. ft. (24 kg/cu. m)]** **<Insert value>**.
    - c. Plastic Sheet Thickness and Color: Not less than **0.003 inch (0.076 mm)**; **[clear]** **[flat black]** **[white]**.
  2. Unwrapped, Glass-Fiber Insulation: Black coated, unfaced, complying with ASTM C 553, Type I, Type II, or Type III; not less than **1-lb/cu. ft. (16-kg/cu. m)** density; treated to be nondusting; **[1 inch (25 mm)]** **[1-1/2 inches (38 mm)]** **<Insert dimension>** thick.
  3. Spacer Grids: Provide manufacturer's standard **[aluminum]** **[galvanized-steel]** grid units that provide an air cushion between metal pans and insulation pads and that act to improve sound absorption.

- H. Sound Attenuation Panels: Provide manufacturer's standard **[aluminum]** **[galvanized-steel]** unperforated metal backing unit that acts as a sound attenuation pan to reduce the travel of sound through ceiling plenum into adjoining rooms.
1. Sound-Absorbent Pads: Provide secondary sound-absorbent pads, **[same as specified for primary sound-absorbent pads]** **<Insert requirements>**, for placement over sound attenuation pan to reduce plenum sound.
- I. Adhesive: Manufacturer's standard nonflammable adhesive for sound-absorbent **[fabric]** **[and]** **[pads]**.
1. Adhesive shall have a VOC content of **[50]** **<Insert number>** g/L or less.
  2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings](#); **<Insert product name or designation>**.
  2. [Armstrong World Industries, Inc.](#); **<Insert product name or designation>**.
  3. [Ceilings Plus](#); **<Insert product name or designation>**.
  4. [Chicago Metallic Corporation](#); **<Insert product name or designation>**.
  5. [Gage Corporation International \(The\)](#); **<Insert product name or designation>**.
  6. [Hunter Douglas Architectural Products, Inc.](#); **<Insert product name or designation>**.
  7. [Simplex Ceilings, a division of Intalite Inc.](#); **<Insert product name or designation>**.
  8. [Steel Ceilings Inc.](#); **<Insert product name or designation>**.
  9. [USG Interiors, Inc.](#); **<Insert product name or designation>**.
  10. **<Insert manufacturer>**
  11. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for **[Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing]** **[Type XX, other types described as perforated aluminum facing (pan) units with sound-absorbent fabric backing]** **[Type XX, other types described as unperforated aluminum facing (pan) units]** **<Insert Type XX description>**.
1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in **[diagonal]** **[parallel]** alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as **[indicated by product designation]** **[selected from manufacturer's full range]**.
  2. Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area

- as [specified by product designation] [selected from manufacturer's full range].
3. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, percent open area, and border requirements>.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
  2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
  3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
  4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
  5. <Insert type and description>.
- D. Pan Thickness: Not less than [0.019 inch (0.5 mm)] [0.025 inch (0.6 mm)] [0.032 inch (0.8 mm)] [0.040 inch (1.0 mm)] <Insert dimension>.
- E. Pan Edge Detail: [Square] [Beveled] [Reveal] [Manufacturer's standard edge detail].
- F. Pan Joint Detail: [Butt] [Wide reveal, not less than 15/16 inch (24 mm) wide] [Narrow reveal, not greater than 9/16 inch (15 mm) wide] [Flush narrow reveal, not greater than 9/16 inch (15 mm) wide] <Insert description>.
- G. Pan Size: [12 by 12 inches (305 by 305 mm)] [12 by 24 inches (305 by 610 mm)] [12 by 36 inches (305 by 915 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [24 by 60 inches (610 by 1525 mm)] [30 by 30 inches (760 by 760 mm)] [30 by 60 inches (760 by 1525 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Scoring: Score pans at intervals to appear as [12-by-12-inch (305-by-305-mm)] <Insert dimensions> ceiling units.
- I. Pan Face Finish: [Mill] [Lacquered mill] [Clear anodized] [Clear mirror anodized] [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- J. LR: Not less than [0.70] [0.75] <Insert number>.
- K. NRC: Not less than [0.60] [0.65] [0.70] [0.75] [0.80] [0.85] [0.90] [0.95] <Insert number>.
- L. CAC: Not less than [35] [40] [45] <Insert number>.



- 2.4 STEEL PANS FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings](#); <Insert product name or designation>.
  2. [Armstrong World Industries, Inc.](#); <Insert product name or designation>.
  3. [CertainTeed Corp.](#)
  4. [Ceilings Plus](#); <Insert product name or designation>.
  5. [Chicago Metallic Corporation](#); <Insert product name or designation>.
  6. [Hunter Douglas Architectural Products, Inc.](#); <Insert product name or designation>.
  7. [Simplex Ceilings, a division of Intalite Inc.](#); <Insert product name or designation>.
  8. [Steel Ceilings Inc.](#); <Insert product name or designation>.
  9. [USG Interiors, Inc.](#); <Insert product name or designation>.
  10. <Insert manufacturer's name>.
  11. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for [Type V, perforated steel facing (pan) with mineral- or glass-fiber-base backing] [Type XX, other types described as perforated steel facing (pan) units with sound-absorbent fabric backing] [Type XX, other types described as unperforated steel facing (pan) units] <Insert Type XX description>.
1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in [diagonal] [parallel] alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as [indicated by product designation] [selected from manufacturer's full range].
  2. Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area as [specified by product designation] [selected from manufacturer's full range].
  3. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
  2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
  3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
  4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
  5. <Insert type and description>.

- D. Pan Thickness: Not less than [0.010 inch (0.25 mm)] [0.019 inch (0.5 mm)] [0.025 inch (0.6 mm)] [0.030 inch (0.75 mm)] [0.036 inch (0.9 mm)] <Insert dimension>.
- E. Pan Edge Detail: [Square] [Beveled] [Reveal] [Manufacturer's standard edge detail].
- F. Pan Joint Detail: [Butt] [Wide reveal, not less than 15/16 inch (24 mm) wide] [Narrow reveal, not greater than 9/16 inch (15 mm) wide] [Flush narrow reveal, not greater than 9/16 inch (15 mm) wide] <Insert description>.
- G. Pan Size: [12 by 12 inches (305 by 305 mm)] [12 by 24 inches (305 by 610 mm)] [12 by 36 inches (305 by 915 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [24 by 60 inches (610 by 1525 mm)] [30 by 30 inches (760 by 760 mm)] [30 by 60 inches (760 by 1525 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Scoring: Score pans at intervals to appear as [12-by-12-inch (305-by-305-mm)] <Insert dimensions> ceiling units.
- I. Pan Face Finish: [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Plated with metallic finish, as selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- J. LR: Not less than [0.70] [0.75] <Insert number>.
- K. NRC: Not less than [0.60] [0.65] [0.70] [0.75] [0.80] [0.85] [0.90] [0.95] <Insert number>.
- L. CAC: Not less than [35] [40] [45] <Insert number>.
- 2.5 STAINLESS-STEEL PANS FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Ceilings Plus.](#)
  2. [Chicago Metallic Corporation.](#)
  3. [Hunter Douglas.](#)
  4. [Simplex Ceilings; a division of Intalite Inc.](#)
  5. [Steel Ceilings Inc.](#)
  6. <Insert manufacturer's name>.
  7. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for [Type VI, perforated stainless-steel facing (pan) with mineral- or glass-fiber-base backing] [Type XX, other types described as perforated stainless-steel facing (pan) units with

**sound-absorbent fabric backing] [Type XX, other types described as unperforated stainless-steel facing (pan) units] <Insert Type XX description>.**

1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in parallel alignment to pan edge with uniform perforations of **0.109-inch (2.8-mm)** diameter, 1800 holes/sq. ft. or inch, and 11.8 percent open area.
  2. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.**
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
  2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
  3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
  4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
  5. **<Insert type and description>.**
- D. Pan Thickness: Not less than [**0.019 inch (0.5 mm)**] [**0.025 inch (0.6 mm)**] [**0.030 inch (0.76 mm)**] **<Insert dimension>.**
- E. Pan Edge Detail: [**Square**] [**Beveled**] [**Reveal**] [**Manufacturer's standard edge detail**].
- F. Pan Joint Detail: [**Butt**] [**Wide reveal, not less than 15/16 inch (24 mm) wide**] [**Narrow reveal, not greater than 9/16 inch (15 mm) wide**] [**Flush narrow reveal, not greater than 9/16 inch (15 mm) wide**] **<Insert description>.**
- G. Pan Size: [**12 by 12 inches (305 by 305 mm)**] [**12 by 24 inches (305 by 610 mm)**] [**12 by 36 inches (305 by 915 mm)**] [**24 by 24 inches (610 by 610 mm)**] [**24 by 48 inches (610 by 1220 mm)**] [**30 by 30 inches (760 by 760 mm)**] [**As indicated on Drawings**] **<Insert dimensions>.**
- H. Scoring: Score pans at intervals to appear as [**12-by-12-inch (305-by-305-mm)**] **<Insert dimensions>** ceiling units.
- I. Pan Face Finish: [**Directional Satin Finish: No. 4**] [**Dull Satin Finish: No. 6**] [**Mirrorlike Reflective, Nondirectional Polish: No. 8**] **<Insert finish>.**
- J. NRC: Not less than [**0.60**] [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] [**0.95**] **<Insert number>.**
- K. CAC: Not less than [**35**] [**40**] [**45**] **<Insert number>.**

## 2.6 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content of Metal Suspension System: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635/C 635M requirements.
- C. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
- D. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[5] <Insert number>** times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: **[Cast-in-place] [Postinstalled expansion] [Postinstalled bonded]** anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
  2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **[10] <Insert number>** times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel copper alloy for UNS No. N04400 alloy.

4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than [0.106-inch- (2.69-mm-)] [0.135-inch- (3.5-mm-)] <Insert dimension> diameter wire.
- F. [Hanger Rods] [Flat Hangers]: Mild steel, zinc coated or protected with rust-inhibitive paint.
  - G. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
  - H. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
  - I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
  - J. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical metal pans in place.
  - K. Hold-Down Clips: Manufacturer's standard hold-down clips spaced to secure acoustical metal pans in place [to molding and trim at perimeter] [at each pan] <Insert requirements>.
  - L. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units unless otherwise indicated.
    1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
- 2.7 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. [Armstrong World Industries, Inc.](#)
    2. [CertainTeed Corp.](#)
    3. [Chicago Metallic Corporation.](#)
    4. [USG Interiors, Inc.; Subsidiary of USG Corporation.](#)
    5. <Insert manufacturer's name>.
    6. or approved equal.

- B. Suspension System: For **[clip-in]** **[lay-in]** **[torsion-spring-hinged]** **<Insert type>** pans.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide sheet metal caps on flanges.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
  2. End Condition of Cross Runners: **[Override (stepped)]** **[or]** **[butt-edge]** type.
  3. Face Design: Flat, flush.
  4. Cap Material: **[Steel]** **[or]** **[aluminum]** cold-rolled sheet.
  5. Cap Finish: **[Painted white]** **[Painted in color as selected from manufacturer's full range]** **[Painted to match color indicated by manufacturer's designation]** **[Painted to match color of metal pan]** **[Plated with metallic finish, as selected from manufacturer's full range]** **[Plated with metallic finish indicated by manufacturer's designation]** **[Natural finish for aluminum]**.
- D. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **9/16-inch-** (15-mm-) wide sheet metal caps on flanges.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
  2. End Condition of Cross Runners: **[Override (stepped)]** **[or]** **[butt-edge]** type.
  3. Face Design: **[Flat, flush]** **[Flanges formed with an integral center reveal]**.
  4. Cap Material: **[Steel]** **[or]** **[aluminum]** cold-rolled sheet.
  5. Cap Finish: **[Painted white]** **[Painted in color as selected from manufacturer's full range]** **[Painted to match color indicated by manufacturer's designation]** **[Painted to match color of metal pan]** **[Plated with metallic finish, as selected from manufacturer's full range]** **[Plated with metallic finish indicated by manufacturer's designation]** **[Natural finish for aluminum]**.
- E. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized, to produce structural members with **9/16-inch-** (15-mm-) wide faces.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
  2. Face Design: With **[1/8-inch-** (3.2-mm-)] **[1/4-inch-** (6.35-mm-)] wide, slotted, box-shaped flange.
  3. Face Finish: Painted **[white]** **[in color as selected from manufacturer's full range]** **[to match color indicated by manufacturer's designation]** **[to match color of metal pan]**.
- F. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide aluminum caps on flanges.

1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
  2. Face Design: Flat, flush.
  3. Face Finish: **[Painted white] [Painted to match color indicated by manufacturer's designation] [Painted to match color of acoustical unit] [Natural finish]**.
- G. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from and capped with Type 304 or Type 316 stainless-steel sheet, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide stainless-steel caps on flanges.
1. Structural Classification: Intermediate-duty system.
  2. Face Design: Flat, flush.
  3. Finish: **[Directional Satin Finish: No. 4] [Dull Satin Finish: No. 6] [Mirrorlike Reflective, Nondirectional Polish: No. 8] <Insert finish>**.
- H. Suspension System for Torsion-Spring-Hinged Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring-hinged attachment.
- 2.8 METAL SUSPENSION SYSTEM FOR ACOUSTICAL SNAP-IN METAL PAN CEILING  
<Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by snap-in metal pan ceiling manufacturer.
- B. Indirect-Hung, Snap-**[Tee] [Bar]** System: Designed to support metal pans that snap into main runners, consisting of main runners connected to carrying channels that are attached by hangers to building structure, and complying with the following requirements:
1. Main Runners: Formed from the following metal:
    - a. Aluminum Sheet: Alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with **ASTM B 209** (ASTM B 209M).
    - b. Electrolytic Zinc-Coated Steel Sheet: ASTM A 879/A 879M, with not less than **[08Z (24G)] <Insert coating designation>** zinc coating.
    - c. Hot-Dip Galvanized Steel: ASTM A 653/A 653M, with not less than **[G60 (Z180)] <Insert coating designation>** zinc coating.
    - d. Stainless-Steel Sheet: ASTM A 666, Type 302 or Type 304, stretcher leveled, with cold-rolled mill finish.
    - e. Metal Sheet: Metal as standard with ceiling system manufacturer, with factory-applied protective finish complying with ASTM C 635/C 635M.
  2. Carrying Channels: Same member and metal as indicated for main runners.
  3. Carrying Channels: Cold-rolled steel, not less than **0.060-inch** (1.5-mm) nominal thickness of base (uncoated) metal and **7/16-inch-** (11-mm-) wide flanges, **[protected with rust-inhibitive paint] [hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation]**, and as follows:

- a. Depth and Weight: [1-1/2 inches and 475 lb/1000 feet (38 mm and 215 kg/305 m)] [2 inches and 590 lb/1000 feet (51 mm and 268 kg/305 m)].
4. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, G60 (Z180) coating designation; size and profile as required to withstand wind load.
- C. Direct-Hung, Snap-[Tee] [Bar] System: Designed to support metal pans that snap into main runners, consisting of main runners supported by hangers attached directly to building structure, and complying with the following requirements:
  1. Hangers: Angles or channels, as standard with ceiling system manufacturer, formed from same metal as main runners.
  2. Main Runners: Rolled aluminum sheet; alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with ASTM B 209 (ASTM B 209M).
- D. Access Panels: For access at locations indicated, provide acoustical snap-in metal pan ceiling units, accessible by [key or tool] [two access knobs; place one access knob at each end of panel near corners].
  1. Access Key or Tool: Provide manufacturer's standard key or tool for opening access panels; [one] [two] <Insert number>.

## 2.9 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
    - c. <Insert manufacturer's name; product name or designation>.
    - d. or approved equal.
  2. Acoustical Sealant for Concealed Joints:
    - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
    - b. Pecora Corporation; AIS-919.
    - c. Tremco, Inc.; Tremco Acoustical Sealant.
    - d. <Insert manufacturer's name; product name or designation>.
    - e. or approved equal.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.



2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall have a VOC content of [250] <Insert number> g/L or less.
4. Acoustical sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

## 2.11 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10 (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned).
- B. Lacquered Mill Finish: AA-M10C10R1x (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned; Organic Coating: as specified below).
  1. Organic Coating: Manufacturer's standard clear organic coating.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard [ powder-coat] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

## 2.12 METALLIC-COATED STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard [ **powder-coat** ] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

## 2.13 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

## 2.14 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical metal pan ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans

at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

### 3.3 INSTALLATION

- A. General: Install acoustical metal pan ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and hanger type involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to CISCA's "Metal Ceilings Technical Guidelines."
1. For lay-in, square-edge pans, install pans with edges fully hidden from view by flanges of suspension-system runners and moldings.
  2. For lay-in, reveal-edge pans on suspension-system runners, install pans with bottom of reveal in firm contact with top surface of runner flanges.
  3. For lay-in, reveal-edge pans on suspension-system members with box-shaped flanges, install pans with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  4. For **[clip-in] [torsion-spring-hinged]** pans, position pans according to manufacturer's written instructions.
  5. For snap-in pans, fit adjoining units to form flush, tight joints.
  6. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
  7. Fit adjoining units to form flush, tight joints.
  8. Install directionally patterned or textured metal pans in directions indicated.
  9. Install sound-absorbent fabric layers in, and bond to, perforated metal pans.
  10. Install sound-absorbent pads in perforated metal pans[ **over metal spacer grids**].
- H. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system and close major openings to form complete coverage in required areas. Lay second sound-absorbent pads on sound attenuation panels.
- I. Install hold-down clips where indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:
  - 1. Seismic design compliance.
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical metal panel ceiling hangers, anchors, and fasteners in successive stages. Do not proceed with installations of acoustical metal panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
  - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for **200 lbf (890 N)** of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for **440 lbf (1957 N)** of tension.
    - b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.
- D. Acoustical metal panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.5 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 095133

## SECTION 095423 - LINEAR METAL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes strip linear metal pans and suspension systems for ceilings.
- B. Related Sections:
  - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
  - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
  - 3. Section 095133 "Acoustical Metal Pan Ceilings" for clip-in, lay-in, snap-in, and torsion-spring-hinged metal pan ceilings with exposed suspension systems.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.
  - 1. Wind Load: Uniform pressure [~~of 20 lbf/sq. ft. (960 Pa)~~] [~~of 30 lbf/sq. ft. (1436 Pa)~~] **[as indicated on Drawings]** <Insert pressure>, acting inward or outward.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] <Insert temperature range>, material surfaces.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
  - 1. Linear Metal Pan: Set of 12-inch- (300-mm-) long Samples of each type and color and a 12-inch- (300-mm-) long spliced section.
  - 2. Suspension System Members: 12-inch- (300-mm-) long Sample of each type.
  - 3. Exposed Molding and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
  - 4. Filler Strips: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
  - 5. Sound Absorber: 12 inches (300 mm) long.
  - 6. End Cap: Full size.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Linear pattern.
  - 2. Joint pattern.
  - 3. Ceiling suspension members.
  - 4. Method of attaching hangers to building structure.
    - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.



6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
7. Minimum Drawing Scale: [1/4 inch = 1 foot (1:48)] [1/8 inch = 1 foot (1:96)] [1:50] [1:100] <Insert scale>.

- B. Qualification Data: For [ **professional engineer and** ] testing agency.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each linear metal ceiling.
- D. Evaluation Reports: For linear metal ceiling and components [ **and anchor type** ].
- E. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to [2] <Insert number> percent of quantity installed.

#### 1.9 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations: Obtain each set of linear metal pans and suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.
- C. Surface-Burning Characteristics: Complying with ASTM E 1264 for [ **Class A** ] <Insert class> materials, as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- D. Seismic Standard: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
  2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
  3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
  4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
  5. SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
  6. **<Insert requirement of authorities having jurisdiction>.**
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

#### 1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install linear metal ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

#### 1.12 COORDINATION

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## 1.13 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 LINEAR METAL CEILING PANS

- A. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches** (400 mm) away from test surface per ASTM E 795.
- B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
1. Aluminum Sheet: Roll-formed aluminum sheet, complying with **ASTM B 209** (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
  2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635.
    - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 591/A 591M, **40Z** (12G) coating; surface treatment as recommended by finish manufacturer for type of use and finish indicated.
    - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
  3. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, [**Type 304**] [**Type 430**].
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.
- D. Pan Splices: Construction same as pans, in lengths **8 to 12 inches** (200 to 300 mm); with manufacturer's standard finish.
- E. End Caps: [**Metal matching pans**] [**Plastic**] [**Manufacturer's standard material**]; fabricated to fit and conceal exposed ends of pans.

- F. Filler Strips: **[Metal matching pans] [Plastic] [Manufacturer's standard material]**; fabricated to uninterrupted close voids between pans.
- G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.
- H. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
1. Bond fabric layer to pan in the factory with manufacturer's standard nonflammable adhesive.
- I. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:
1. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:
    - a. Mineral-Fiber Type and Thickness: Glass fiber; [1 inch (25 mm)] [1-1/2 inches (38 mm)] [3 inches (76 mm)] **<Insert thickness>**.
    - b. Mineral-Fiber Density: [3/4 lb/cu. ft. (12 kg/cu. m)] [1 lb/cu. ft. (16 kg/cu. m)] [1-1/2 lb/cu. ft. (24 kg/cu. m)] **<Insert density>**.
    - c. Plastic Sheet Thickness and Color: Not less than 0.003 inch (0.076 mm); [clear] [flat black] [white].
    - d. Plastic Sheet Thickness and Color: **<Insert requirements>**.
  2. Unwrapped, Glass-Fiber Insulation: Black-coated, unfaced, glass-fiber insulation complying with ASTM C 553, Type I, II, or III, not less than 1-lb/cu. ft. (16-kg/cu. m) density, treated to be nondusting, and as follows:
    - a. Thickness: [1 inch (25 mm)] [1-1/2 inches (38 mm)] **<Insert thickness>**.

## 2.2 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[five]** **<Insert safety factor>** times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: **[Cast-in-place]** **[Postinstalled expansion]** **[Postinstalled bonded]** anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchors.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
  2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **[10]** **<Insert safety factor>** times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
  4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung will be less than yield stress of wire, but provide not less than **[0.106-inch-** (2.69-mm-)] **[0.135-inch-** (3.5-mm-)] **<Insert dimension>** diameter wire.
- E. **[Hanger Rods]** **[Flat Hangers]**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide; formed from **0.04-inch-** (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90** (Z275) coating designation; with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
- G. Carriers: Factory finished **[with matte-black baked finish]** **<Insert finish description>**.

1. Main Carriers: Aluminum, not less than **0.240-inch** (6.0-mm) rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with **ASTM B 209** (ASTM B 209M).
  2. Main Carriers: Steel, not less than **0.0209-inch** (0.53-mm) nominal thickness, cold-rolled sheet, with factory-applied protective coating, complying with ASTM C 635.
    - a. Electrolytic Zinc-Coated Steel: ASTM A 591/A 591M, not less than [**80Z** (24G)] **<Insert coating designation>** zinc coating.
    - b. Hot-Dip Galvanized Steel: ASTM A 653/A 653M, not less than [**G60** (Z180)] **<Insert coating designation>** zinc coating.
  3. Adaptable Carriers: Manufacturer's standard carriers for direct attachment to existing suspended tees.
  4. Flexible Radial Carriers: Manufacturer's standard radial carriers.
  5. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
- H. Carrier Splices: Same metal, profile, and finish as indicated for carriers.
- I. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, **G60** (Z180) coating designation; size and profile as required to withstand wind load.
- L. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.
- M. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.
  1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
  2. **<Insert requirements>**.
- 2.3 ALUMINUM PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING  
**<Insert drawing designation>**
- A. Aluminum Pans and Suspension System:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. American Decorative Ceilings; **<Insert product name or designation>**.
  - b. Ceilings Plus; **<Insert product name or designation>**.
  - c. Chicago Metallic Corporation; **<Insert product name or designation>**.
  - d. Hunter Douglas Architectural Products, Inc.; **<Insert product name or designation>**.
  - e. Simplex Ceilings, a division of Intalite Inc.; **<Insert product name or designation>**.
  - f. USG Interiors, Inc.; **<Insert product name or designation>**.
  - g. **<Insert manufacturer's name; product name or designation>**.
  - h. or approved equal.
  
- B. Classification: Units complying with ASTM E 1264 for **[Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 1, perforated] [Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 2, unperforated] [Type XX, other types described as perforated aluminum strips with sound-absorbent fabric backing] <Insert Type XX description>**.
  1. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>**.
  
- C. Pan Thickness: Not less than **[0.018 inch (0.46 mm)] [0.022 inch (0.56 mm)] [0.024 inch (0.6 mm)] [0.025 inch (0.65 mm)] [0.027 inch (0.7 mm)] [0.032 inch (0.8 mm)] [0.040 inch (1.0 mm)] <Insert thickness>**.
  
- D. Pan Edge Detail: **[Beveled] [Square] [Round] [Manufacturer's standard edge detail]**.
  
- E. Linear Module Width and Pan Face Width: **[2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width] [4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width] [6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width] [8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width] [100-mm module width and 80-mm face width] [200-mm module width and 180-mm face width] [300-mm module width and 280-mm face width] [As indicated on Drawings] <Insert dimensions>**.
  
- F. Pan Depth: **[5/8 inch (16 mm) deep] [3/4 inch (19 mm) deep] [Not less than 1 to 1-1/2 inches (25 to 38 mm) deep] [15 mm deep] [As indicated] <Insert depth>**.
  
- G. Pan Face Finish: **[Mill] [Lacquered mill] [Clear anodized] [Clear mirror-anodized] [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [High-performance organic coating in color selected from manufacturer's full range] [Bright-reflective finish selected from manufacturer's full range] <Insert finish>**.
  
- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish]**.

- I. Filler Strip Design: [**Recessed**] [**Flush**] [**An integral extension of pan profile**] [**Expansion, for use with expansion carriers**] [**Slotted, for air diffusion**].
  - J. Filler Strip, Finish of Exposed Portions: [**Matte black**] [**To match pan**].
  - K. LR: Not less than [**0.70**] [**0.75**] <Insert LR>.
  - L. NRC: Not less than [**0.65**] [**0.75**] [**0.95**] <Insert NRC>.
  - M. Suspension-System Main-Carrier Material: [**Aluminum**] [**Electrolytic zinc-coated steel**] [**Hot-dip galvanized steel**] [**Manufacturer's standard material and protective finish**].
- 2.4 STEEL PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING <Insert drawing designation>
- A. Steel Pans and Suspension System:
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. Ceilings Plus; <Insert product name or designation>.
      - b. Chicago Metallic Corporation; <Insert product name or designation>.
      - c. Hunter Douglas Architectural Products, Inc.; <Insert product name or designation>.
      - d. USG Interiors, Inc.; <Insert product name or designation>.
      - e. <Insert manufacturer's name; product name or designation>.
      - f. or approved equal.
  - B. Classification: Units complying with ASTM E 1264 for [**Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 1, perforated**] [**Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 2, unperforated**] [**Type XX, other types described as perforated steel strips with sound-absorbent fabric backing**] <Insert Type XX description>.
    - 1. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.
  - C. Pan Thickness: Not less than [**0.015 inch (0.4 mm)**] [**0.020 inch (0.5 mm)**] [**0.024 inch (0.6 mm)**] [**0.030 inch (0.75 mm)**] <Insert thickness>.
  - D. Pan Edge Detail: [**Beveled**] [**Square**] [**Round**] [**Manufacturer's standard edge detail**].
  - E. Linear Module Width and Pan Face Width: [**2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width**] [**4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width**] [**6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width**] [**8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width**] [**As indicated on Drawings**] <Insert dimensions>.



- F. Pan Depth: **[5/8 inch (16 mm) deep] [3/4 inch (19 mm) deep] [Not less than 1 to 1-1/2 inches (25 to 38 mm) deep] [15 mm deep] [As indicated] <Insert depth>**.
- G. Pan Face Finish: **[Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Electroplated finish selected from manufacturer's full range] <Insert finish>**.
- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish]**.
- I. Filler Strip Design: **[Recessed] [Flush] [An integral extension of pan profile] [Expansion, for use with expansion carriers] [Slotted, for air diffusion]**.
- J. Filler Strip, Finish of Exposed Portions: **[Matte black] [To match pan]**.
- K. LR: Not less than **[0.70] [0.75] <Insert LR>**.
- L. NRC: Not less than **[0.65] [0.75] [0.95] <Insert NRC>**.
- M. Suspension-System Main-Carrier Material: **[Aluminum] [Electrolytic zinc-coated steel] [Hot-dip galvanized steel] [Manufacturer's standard material and protective finish]**.
- 2.5 STAINLESS-STEEL PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING **<Insert drawing designation>**
- A. Stainless-Steel Pans and Suspension System:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Decorative Ceilings; **<Insert product name or designation>**.
    - b. Ceilings Plus; **<Insert product name or designation>**.
    - c. **<Insert manufacturer's name; product name or designation>**.
    - d. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for **[Type XIII, stainless-steel strips with mineral- or glass-fiber-base backing; Form 1, perforated] [Type XIII, stainless-steel strips with mineral- or glass-fiber-base backing; Form 2, unperforated] [Type XX, other types described as perforated stainless-steel strips with sound-absorbent fabric backing] <Insert Type XX description>**.
1. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot, and percent open area>**.
- C. Pan Thickness: Not less than **[0.016 inch (0.396 mm)] [0.019 inch (0.475 mm)] <Insert thickness>**.
- D. Pan Edge Detail: **[Manufacturer's standard edge detail] <Insert edge detail>**.

- E. Linear Module Width and Pan Face Width: **[2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width] [4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width] [6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width] [8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width] [As indicated on Drawings] <Insert dimensions>.**
- F. Pan Depth: **[5/8 inch (16 mm) deep] [As indicated] <Insert depth>.**
- G. Pan Face Finish: **[Brushed, directional polish] [Satin, directional polish] [Mirrorlike reflective, nondirectional polish] <Insert finish>.**
- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish].**
- I. Filler Strip Design: **[Recessed] [Flush] [An integral extension of pan profile] [Expansion, for use with expansion carriers] [Slotted, for air diffusion].**
- J. Filler Strip, Finish of Exposed Portions: **[Matte black] [To match pan].**
- K. NRC: Not less than **[0.65] [0.75] [0.95] <Insert NRC>.**
- L. Suspension-System Main-Carrier Material: **[Aluminum] [Electrolytic zinc-coated steel] [Hot-dip galvanized steel] [Manufacturer's standard material and protective finish].**

## 2.6 ACCESSORIES

- A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10.

- B. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard[ **powder-coat**] baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- G. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

## 2.9 GALVANIZED-STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard[ **powder-coat**] baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

## 2.10 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

## 2.11 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of linear metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width or -length pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

#### 3.3 INSTALLATION

- A. Comply with **[ASTM C 636]** **[UBC Standard 25-2]** and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type

- of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than **48 inches** (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches** (200 mm) from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.
1. Screw attach moldings to substrate at intervals not more than **16 inches** (400 mm) o.c. and not more than **3 inches** (75 mm) from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet** (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- G. Install linear metal pans in coordination with suspension system and exposed moldings and trim.
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
  2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
  3. Install pans with butt joints using internal pan splices and in the following joint configuration:
    - a. Aligned.
    - b. Aligned, every other pan length.

- c. Staggered a minimum of **12 inches** (300 mm).
  - d. Random.
  - e. As indicated.
- 4. Install directionally textured metal pans in directions indicated.
  - 5. Where metal pan ends are visible, install end caps unless trim is indicated.
  - 6. Install filler strips where indicated.
  - 7. Install sound-absorbent fabric layers in perforated metal pans.
  - 8. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.
- H. Install hold-down clips where indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage]** a qualified special inspector to perform the following special inspections:
- 1. Suspended ceiling system.
  - 2. Hangers, anchors, and fasteners.
  - 3. **<Insert special inspections>**.
- B. Testing Agency: **[Owner will engage]** a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
- 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf** (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf** (1957 N) of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.5 CLEANING

- A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 095423

## SECTION 095436 - SUSPENDED DECORATIVE GRIDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes rigid, open-frame, suspended grids, and suspension systems for ceilings.
- B. Related Requirements:
  - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
  - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
  - 3. Section 095133 "Acoustical Metal Pan Ceilings."
  - 4. Section 095423 "Linear Metal Ceilings."
- C. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

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



1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
  1. Cell Grids: Set of **[full-size] [12-inch- (300-mm-) square] <Insert size>** module Samples of each type, finish, and color.
  2. Beam Grids: Set of **12-inch- (300-mm-)** long Samples of each type, finish, and color; a **12-inch- (300-mm-)** long spliced section; and a **6-inch- (150-mm-)** long per leg corner section.
- F. Delegated-Design Submittal: For design of **[seismic restraints and ]**attachment devices.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Lighting fixtures.
  2. Air outlets and inlets.
  3. Speakers.
  4. Sprinklers.
- B. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Suspended Decorative Grids: Quantity of each suspended decorative grid component, exposed molding, and trim equal to [2] <Insert number> percent of quantity installed.

## 1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockup of typical ceiling area as shown on Drawings.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver suspended decorative grid components to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle suspended decorative grids and accessories carefully to avoid damaging units and finishes in any way.

## 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design [seismic restraints and ]attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.

## 2.2 SUSPENDED DECORATIVE GRIDS, GENERAL

- A. Recycled Content of Suspended Decorative Grid Ceiling: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Sheet Metal Characteristics: Provide sheet metal selected for surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.
1. Aluminum Sheet: Roll-formed aluminum sheet, complying with [ASTM B 209 \(ASTM B 209M\)](#); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
  2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.
    - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, [13Z \(40G\)](#) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
    - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
- C. Grid Fabrication: Components are formed from metal indicated. Manufacturer's standard units of size, shape, and profile indicated; finished to comply with requirements indicated. **[ Provide cells factory assembled into modular panel.]**
- D. Cover Profiles and Trim: Provide manufacturer's standard cover profiles and trim for exposed members, and as indicated or required, for edges of grids, at changes in ceiling height, and for other conditions, of same metal and finish as suspended decorative grids.
- E. Metal Suspension-System Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635/C 635M requirements. Provide systems complete with runners or beams, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, web covers, load-resisting struts, fixture filler pans, clips and adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
- F. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[5] <Insert number>** times that imposed by ceiling construction, as determined by testing

according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: [**Cast-in-place**] [**Postinstalled expansion**] [**Postinstalled bonded**] anchors.
  - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
2. Power-Actuated Fasteners in Concrete (If Approved by DEN Project Manager): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to [**10**] <Insert number> times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing agency.
- G. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Size: Select wire diameter so its stress at 3 times hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than [**0.106-inch-** (2.69-mm-)] [**0.135-inch-** (3.5-mm-)] diameter wire.
- H. [**Hanger Rods**] [**Flat Hangers**]: Mild steel, zinc coated or protected with rust-inhibitive paint.
- I. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide; formed with **0.04-inch-** (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90** (Z275) coating designation; with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Exposed Metal Edge Moldings, Covers, Trim, and Fixture Filler Panels: Provide exposed members as indicated or required to conceal edges of and penetrations through ceiling, to conceal edges of beams, to cover runner webs, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching suspended decorative grids unless otherwise indicated.
1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

- 2.3 ALUMINUM GRID UNITS FOR SUSPENDED DECORATIVE GRIDS <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings.](#)
  2. [Ceilings Plus.](#)
  3. [Chicago Metallic Corporation.](#)
  4. [Gordon, Inc..](#)
  5. [Hunter Douglas Architectural Products, Inc..](#)
  6. [Simplex Ceilings, a division of Intalite Inc..](#)
  7. [Steel Ceilings Inc..](#)
  8. <Insert manufacturer's name>.
  9. or approved equal.
- B. Sheet Metal Thickness: Not less than [0.016 inch (0.41 mm)] [0.018 inch (0.46 mm)] [0.020 inch (0.5 mm)] [0.024 inch (0.6 mm)] [0.032 inch (0.8 mm)] <Insert dimension>.
- C. Beam Grid Module: [8 inches (200 mm) square] [12 inches (300 mm) square] [18 inches (460 mm) square] [24 inches (600 mm) square] [30 inches (760 mm) square] [36 inches (900 mm) square] [48 inches (1200 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] <Insert dimensions>.
- D. Beam Width by Height: [2 by 2 inches (50 by 50 mm)] [2 by 4 inches (50 by 100 mm)] [3 by 3 inches (75 by 75 mm)] [4 by 4 inches (100 by 100 mm)] [As indicated on Drawings] <Insert dimensions>.
- E. Cell Panel Module: [24 inches (600 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] [Manufacturer's standard].
- F. Cell Module: [2 inches (50 mm) square] [3 inches (75 mm) square] [4 inches (100 mm) square] [6 inches (150 mm) square] [8 inches (200 mm) square] [12 inches (300 mm) square] [As indicated on Drawings] <Insert dimension>.
- G. Cell Profile, Width by Height: [3/8 by 2 inches (9.5 by 50 mm)] [3/8 by 4 inches (9.5 by 100 mm)] [9/16 by 2 inches (14 by 50 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Finish: [Lacquered mill] [Clear anodized] [Clear mirror anodized] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.

- 2.4 STEEL GRID UNITS FOR SUSPENDED DECORATIVE GRIDS <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings.](#)
  2. [Chicago Metallic Corporation.](#)
  3. [Hunter Douglas Architectural Products, Inc..](#)
  4. [Simplex Ceilings, a division of Intalite Inc..](#)
  5. [USG Interiors, Inc..](#)
  6. <Insert manufacturer's name>.
  7. or approved equal.
- B. Sheet Metal Thickness: Not less than [0.020 inch (0.5 mm)] [0.024 inch (0.6 mm)] <Insert dimension>.
- C. Beam Grid Module: [8 inches (200 mm) square] [12 inches (300 mm) square] [18 inches (460 mm) square] [24 inches (600 mm) square] [30 inches (760 mm) square] [36 inches (900 mm) square] [48 inches (1200 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] <Insert dimensions>.
- D. Beam Width by Height: [2 by 2 inches (50 by 50 mm)] [2 by 4 inches (50 by 100 mm)] [3 by 3 inches (75 by 75 mm)] [4 by 4 inches (100 by 100 mm)] [As indicated on Drawings] <Insert dimensions>.
- E. Cell Panel Module: [24 inches (600 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] [Manufacturer's standard].
- F. Cell Module: [1 inch (25 mm) square] [2 inches (50 mm) square] [3 inches (75 mm) square] [4 inches (100 mm) square] [6 inches (150 mm) square] [8 inches (200 mm) square] [12 inches (300 mm) square] [24 inches (600 mm) square] [As indicated on Drawings] <Insert dimension>.
- G. Cell Profile, Width by Height: [3/8 by 2 inches (9.5 by 50 mm)] [9/16 by 2 inches (14 by 50 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Finish: [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Plated with metallic finish, as selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- 2.5 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Clear Mirror Anodic Finish: AA-M21C12A212, Class II, 0.005 mm or thicker.
- C. Color-Coated Finish: Manufacturer's standard [ **powder-coat** ] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- D. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

## 2.7 METALLIC-COATED STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard [ **powder-coat** ] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

## 2.8 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended decorative grids attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling

installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of suspended decorative grids.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of suspended decorative grids to balance border widths at opposite edges of each space. Comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install suspended decorative grids to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached and for hanger type involved.
  - 5. Do not support grids directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 6. Do not attach hangers to steel deck tabs.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of each suspended decorative grid and where necessary to conceal edges of grids.
  - 1. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, level with ceiling system to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)**. Miter corners accurately and connect securely.



2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspended decorative grids in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to CISCA's "Metal Ceilings Technical Guidelines."

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints.
3. Where grid edges are visible, install cover profiles unless other trim is indicated.

### 3.4 FIELD QUALITY CONTROL

A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:

1. Seismic design compliance.

B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of grid hangers, anchors, and fasteners in successive stages. Do not proceed with installations of grid hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of grid systems on each floor has reached 20 percent completion but no panels have been installed.
  - a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for **200 lbf (890 N)** of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for **440 lbf (1957 N)** of tension.
  - b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.

D. Suspended decorative grid hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare tests and inspection reports.

### 3.5 CLEANING

A. Clean exposed surfaces of suspended decorative grids, including trim and edge moldings, after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace grid components

that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed grids.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 095436

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

- B. Related Sections:

1. Section 096516 "Resilient Sheet Flooring" for resilient sheet floor coverings.
2. Section 096516.13 "Linoleum Flooring" for linoleum floor coverings.
3. Section 096519 "Resilient Tile Flooring" for resilient floor tile.
4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

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

#### 1.3 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than **12 inches** (300 mm) long, of each resilient product color, texture, and pattern required.
- E. Product Schedule: For resilient products.[ **Use same designations indicated on Drawings.**]

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than [**10 linear feet** (3 linear m)] **<Insert length>** for every [**500 linear feet** (150 linear m)] **<Insert length>** or fraction thereof, of each type, color, pattern, and size of resilient product installed.

#### 1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** (10 deg C) or more than **90 deg F** (32 deg C).

#### 1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [**70 deg F** (21 deg C)] **<Insert temperature>** or more than [**95 deg F** (35 deg C)] **<Insert temperature>**, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## 1.9 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 RESILIENT BASE <Insert drawing designation>

- A. Resilient Base:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allstate Rubber Corp.; Stoler Industries.
    - b. Armstrong World Industries, Inc.
    - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
    - e. Estrie Products International; American Biltrite (Canada) Ltd.
    - f. Flexco, Inc.
    - g. Johnsonite.
    - h. Mondo Rubber International, Inc.
    - i. Musson, R. C. Rubber Co.
    - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
    - k. PRF USA, Inc.
    - l. Roppe Corporation, USA.
    - m. VPI, LLC; Floor Products Division.
    - n. <Insert manufacturer's name>.
    - o. or approved equal.
- B. Resilient Base Standard: ASTM F 1861.
1. Material Requirement: [Type TV (vinyl, thermoplastic)] [Type TS (rubber, vulcanized thermoset)] [Type TP (rubber, thermoplastic)] [Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic)].

2. Manufacturing Method: [**Group I (solid, homogeneous)**] [**Group II (layered)**] [**Group I (solid, homogeneous) or Group II (layered)**].
  3. Style: [**Cove (base with toe)**] [**Straight (flat or toeless)**] [**Butt to (fit-to-floor)**] <Insert special style>.
- C. Minimum Thickness: [**0.125 inch** (3.2 mm)] [**0.080 inch** (2.0 mm)] <Insert thickness>.
- D. Height: [**2-1/2 inches** (64 mm)] [**4 inches** (102 mm)] [**6 inches** (152 mm)] [**As indicated on Drawings**].
- E. Lengths: [**Cut lengths, 48 inches** (1219 mm) **long**] [**Coils in manufacturer's standard length**] [**Cut lengths 48 inches** (1219 mm) **long or coils in manufacturer's standard length**].
- F. Outside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].
- G. Inside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].
- H. Finish: [**Satin**] [**Matte**] [**Low luster**] [**As selected by DEN Project Manager from manufacturer's full range**].
- I. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
- 2.2 RESILIENT STAIR ACCESSORIES <Insert drawing designation>
- A. Resilient Stair Treads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    - b. Endura Rubber Flooring; Division of Burke Industries, Inc.
    - c. Estrie Products International; American Biltrite (Canada) Ltd.
    - d. Flexco, Inc.
    - e. Johnsonite.
    - f. Mondo Rubber International, Inc.
    - g. Musson, R. C. Rubber Co.
    - h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
    - i. PRF USA, Inc.
    - j. R.C.A. Rubber Company (The).
    - k. Roppe Corporation, USA.
    - l. VPI, LLC; Floor Products Division.
    - m. <Insert manufacturer's name>.
    - n. or approved equal.
- B. Resilient Stair Treads Standard: ASTM F 2169.

1. Material Requirement: **[Type TV (vinyl, thermoplastic)] [Type TS (rubber, vulcanized thermoset)] [Type TP (rubber, thermoplastic)] [Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic)].**
  2. Surface Design:
    - a. Class 1, Smooth (flat).
    - b. Class 2, Pattern: **[Raised-disc design] [Raised-square design] [Raised-chevron design] [Raised-diamond design] [Raised-rib design] [Raised-rib design with abrasive strips] <Insert pattern>.**
  3. Manufacturing Method: **[Group 1, tread with embedded abrasive strips] [Group 2, tread with contrasting color for the visually impaired].**
- C. Nosing Style: **[Square, adjustable to cover angles between 60 and 90 degrees] [Square] [Round].**
- D. Nosing Height: **[1-1/2 inches (38 mm)] [2 inches (51 mm)] [2-3/16 inches (56 mm)] <Insert dimension>.**
- E. Thickness: **[1/4 inch (6 mm) and tapered to back edge] <Insert thickness>.**
- F. Size: Lengths and depths to fit each stair tread in **[one piece] [one piece or, for treads exceeding maximum lengths manufactured, in equal-length units].**
- G. Risers: Smooth, flat, **[coved-toe, 7 inches (178 mm) high by length matching treads] [toeless, height and length to cover risers];** produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
1. Thickness: **[0.125 inch (3.2 mm)] [0.080 inch (2.0 mm)] <Insert thickness>.**
- H. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from full range of industry colors].
- 2.3 RESILIENT MOLDING ACCESSORY **<Insert drawing designation>**
- A. Resilient Molding Accessory:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    - b. Flexco, Inc.
    - c. Johnsonite.
    - d. R.C.A. Rubber Company (The).
    - e. Roppe Corporation, USA.

- f. VPI, LLC; Floor Products Division.
  - g. **<Insert manufacturer's name>**.
  - h. or approved equal.
- B. Description: [**Cap for cove carpet**] [**Cap for cove resilient floor covering**] [**Carpet bar for tackless installations**] [**Carpet edge for glue-down applications**] [**Nosing for carpet**] [**Nosing for resilient floor covering**] [**Reducer strip for resilient floor covering**] [**Joiner for tile and carpet**] [**Transition strips**] **<Insert description>**.
- C. Material: [**Vinyl**] [**Rubber**].
- D. Profile and Dimensions: [**As indicated**] **<Insert profile and dimensions>**.
- E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager** from full range of industry colors].

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)[, **except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less**].
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
  - 4. Moisture Testing: Perform tests recommended by manufacturer[ **and as follows**]. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum [75 percent] **<Insert acceptable percentage>** relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of [**carpet**] [**resilient floor covering**] that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
  2. Sweep and vacuum surfaces thoroughly.
  3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
1. Apply [two] [three] <Insert requirement> coat(s).
- E. Cover resilient products until Substantial Completion.

#### **PART 4 - MEASUREMENT**

A. METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

A. METHOD OF PAYMENT

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

END OF SECTION 096513

## SECTION 096516 - RESILIENT SHEET FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Vinyl sheet floor covering, [**with**] [**and**] [**without**] backing.
- 2. Rubber sheet floor covering, [**with**] [**and**] [**without**] backing.

- B. Related Sections:

- 1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
- 2. Section 096516.13 "Linoleum Flooring" for linoleum sheet floor coverings.
- 3. Section 096519 "Resilient Tile Flooring" for resilient floor tile.
- 4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
- 5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

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

#### 1.3 ACTION SUBMITTALS

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

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

- B. Moisture Tests: Submit test results for moisture tests of concrete substrates.

- C. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For [**adhesives**] [**and**] [**chemical-bonding compounds**], documentation including printed statement of VOC content.
- 2. Product Data for Credit IEQ 4.3: For adhesives [**and chemical-bonding compounds**], documentation including printed statement of VOC content.

3. Product Data for Credit IEQ 4.3: For resilient sheet flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  4. Laboratory Test Reports for Credit IEQ 4: For adhesives **[flooring system]** **[and]** **[chemical-bonding compounds]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
1. Show details of special patterns.
- E. Samples for Initial Selection: For each type of floor covering indicated.
- F. Samples for Verification: In manufacturer's standard size, but not less than **[6-by-9-inch (150-by-230-mm)]** **<Insert size>** sections of each different color and pattern of floor covering required.
1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **[9 inches (230 mm)]** **<Insert dimension>** long, of each color required.
- G. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of **[6-by-9-inch (150-by-230-mm)]** **<Insert size>** Sample applied to a rigid backing and prepared by Installer for this Project.
- H. Product Schedule: For floor coverings. **[ Use same designations indicated on Drawings.]**
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.
  - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Covering: Furnish quantity not less than [10 linear feet (3 linear m)] <Insert length> for every [500 linear feet (150 linear m)] <Insert length> or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation [and seaming method] indicated.
  1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockups for floor coverings including[ resilient base and] accessories.
    - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

## 1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F (21 deg C)] <Insert temperature> or more than [85 deg F (29 deg C)] <Insert temperature>, in spaces to receive floor coverings during the following time periods:
  1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

#### 1.10 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient sheet flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

#### 2.2 VINYL SHEET FLOOR COVERING <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Altro Group; <Insert product name or designation>.
  2. Armstrong World Industries, Inc.; <Insert product name or designation>.
  3. Congoleum Corporation; <Insert product name or designation>.
  4. DzynSpec, Division of Matsinc.; <Insert product name or designation>.
  5. Forbo Flooring, Inc.; <Insert product name or designation>.
  6. Gerflor, Architectural Floor Systems, Inc.; <Insert product name or designation>.
  7. Lonseal, Inc.; <Insert product name or designation>.
  8. Mannington Mills, Inc.; <Insert product name or designation>.
  9. Polyflor, Ltd., Distributed by Gerbert Limited; <Insert product name or designation>.
  10. Tarkett, Inc.; <Insert product name or designation>.
  11. TOLI International; <Insert product name or designation>.
  12. <Insert manufacturer's name; product name or designation>.

13. or approved equal.
- B. Unbacked Vinyl Sheet Floor Covering: ASTM F 1913, [0.080 inch (2.0 mm)] **<Insert dimension>** thick.
- C. Vinyl Sheet Floor Covering with Backing: ASTM F 1303.
1. Type (Binder Content): [**Type I, minimum binder content of 90 percent**] [**Type II, minimum binder content of 34 percent**].
  2. Wear-Layer Thickness: Grade 1.
  3. Overall Thickness: [**As standard with manufacturer**] **<Insert thickness>**.
  4. Interlayer Material: [**Foamed plastic**] [**None**].
  5. Backing Class: [**Class A (fibrous)**] [**Class B (nonfoamed plastic)**] [**Class C (foamed plastic)**].
- D. Wearing Surface: [**Smooth**] [**Embossed**] [**Smooth with embedded abrasives**] [**Embossed with embedded abrasives**].
- E. Sheet Width: [**As standard with manufacturer**] [**4.9 feet (1.5 m)**] [**6 feet (1.8 m)**] [**6.5 feet (1.98 m)**] [**6.6 feet (2.0 m)**] [**9 feet (2.7 m)**] [**12 feet (3.6 m)**].
- F. Seaming Method: [**Heat welded**] [**Chemically bonded**] [**Standard**] **<Insert requirements>**.
- G. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

## 2.3 RUBBER SHEET FLOOR COVERING **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Estrie Products International, American Biltrite (Canada) Ltd.; **<Insert product name or designation>**.
  2. Flexco; **<Insert product name or designation>**.
  3. Johnsonite; **<Insert product name or designation>**.
  4. Mondo Rubber International, Inc.; **<Insert product name or designation>**.
  5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; **<Insert product name or designation>**.
  6. PRF USA Inc.; **<Insert product name or designation>**.
  7. R.C.A. Rubber Company (The); **<Insert product name or designation>**.
  8. **<Insert manufacturer's name; product name or designation>**.
  9. or approved equal.
- B. Unbacked Rubber Sheet Floor Covering: ASTM F 1859.
1. Type: [**Type I (homogeneous rubber sheet)**] [**Type II (layered rubber sheet)**].
  2. Thickness: [**As standard with manufacturer**] **<Insert thickness>**.
- C. Rubber Sheet Floor Covering with Backing: ASTM F 1860.



1. Type: [**Type I, homogeneous rubber sheet with backing**] [**Type II, layered rubber sheet with backing**].
  2. Wear-Layer Thickness: [**As standard with manufacturer**] <Insert thickness>.
  3. Overall Thickness: [**As standard with manufacturer**] <Insert thickness>.
  4. Interlayer Material: [**As standard with manufacturer**] [**None**].
  5. Backing Type: [**Fibrous**] [**Foamed rubber**].
- D. Hardness: [**Not less than required by ASTM F 1859**] [**Not less than required by ASTM F 1860**] [**Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240**].
- E. Wearing Surface: [**Smooth**] [**Textured**] [**Molded pattern**].
1. Molded-Pattern Figure: [**Raised discs**] [**Raised squares**] <Insert pattern>.
- F. Sheet Width: [**As standard with manufacturer**] [**4.9 feet (1.5 m)**] [**6 feet (1.8 m)**] [**6.5 feet (1.98 m)**] [**6.6 feet (2.0 m)**] [**9 feet (2.7 m)**] [**12 feet (3.6 m)**].
- G. Seaming Method: [**Heat welded**] [**Chemically bonded**] [**Standard**] <Insert requirements>.
- H. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
1. Adhesives shall have a VOC content of not more than [**50**] [**60**] <Insert value> g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Seamless-Installation Accessories:
1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
    - a. Color: [**As selected by DEN Project Manager from manufacturer's full range to contrast with floor covering**] [**Match floor covering**] <Insert color>.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
  - a. VOC Content: Not more than 510 g/L. when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - b. Bonding compound shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Integral-Flash-Cove-Base Accessories:
  1. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer.
  2. Cap Strip: **[Square metal, vinyl, or rubber cap] [Tapered vinyl cap] <Insert requirements>** provided or approved by manufacturer.
  3. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by manufacturer[ **and as follows**]. Proceed with installation only after substrates pass testing.
  - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
  - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum **[75 percent]** **<Insert acceptable percentage>** relative humidity level measurement.
  - c. Submit test results to DEN Project Manager.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
  1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

### 3.3 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.
- C. Lay out floor coverings as follows:
  1. Maintain uniformity of floor covering direction.
  2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** (152 mm) away from parallel joints in floor covering substrates.
  3. Match edges of floor coverings for color shading at seams.
  4. Avoid cross seams.
- D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and doorframes.
- E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of

floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

- H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
  - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
  - 2. Chemically-Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly-fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.
- J. Integral-Flash-Cove Base: Cove floor coverings [6 inches (152 mm)] [dimension indicated] <Insert dimension> up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
  - 1. Install metal corners at inside and outside corners.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
  - 1. Remove adhesive and other blemishes from floor covering surfaces.
  - 2. Sweep and vacuum floor coverings thoroughly.
  - 3. Damp-mop floor coverings to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
  - 1. Apply [one] [two] [three] <Insert requirement> coat(s).
- E. Cover floor coverings until Substantial Completion.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096516

## SECTION 096516.13 - LINOLEUM FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Linoleum [**floor tile**] [**sheet flooring**] [**floor tile and sheet flooring**].
- B. Related Sections:
  - 1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with linoleum floor covering.
  - 2. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. Moisture Tests: Submit test results for moisture tests of concrete substrates.
- C. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC contents.
  - 2. Product Data for Credit IEQ 4.3: For adhesives, documentation including printed statement of VOC contents.
  - 3. Product Data for Credit IEQ 4.3: For linoleum, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  - 4. Laboratory Test Reports for Credit IEQ 4: For [**flooring system**] [**and**] [**adhesives**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 1. Show details of special patterns.
- E. Samples for Initial Selection: For each type of floor covering indicated.
  - 1. Include similar Samples of installation accessories involving color selection.
- F. Samples for Verification: In manufacturer's standard size, but not less than [6-by-9-inch (152-by-230-mm)] <Insert size> sections of each color and pattern of floor covering required.
  - 1. Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than [9 inches (230 mm)] <Insert dimension> long, of each color required.
- G. Heat-Welded Seam Samples: For each floor covering product and welding bead color and pattern combination required; with seam running lengthwise and in center of [6-by-9-inch (152-by-230-mm)] <Insert size> Sample applied to rigid backing and prepared by Installer for this Project.
- H. Product Schedule: For floor covering.[ **Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish 1 box for every [50] <Insert number> boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

2. Sheet Flooring: Furnish not less than [10 linear feet (3 linear m)] **<Insert length>** for every [500 linear feet (150 linear m)] **<Insert length>** or fraction thereof, in roll form and in full roll width for each color, pattern, and type of sheet flooring installed.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation.
  1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Delete paragraph (and subparagraphs below) if mockups not required. If retaining, indicate location, size, and other details of mockups on drawings or with inserts. Verify mockup requirements with DEN Project Manager. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockups for floor coverings including[ **integral-flash-cove-base and**] [ **resilient base and**] accessories.
    - a. Size: Minimum 100 sq. ft. (9.2 sq. m) for each type, color, and pattern [in locations indicated] [in locations directed by DEN Project Manager] **<Insert location requirements>**.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 90 deg F (32 deg C).
  1. Floor Tile: Store on flat surfaces.
  2. Sheet Flooring: Store rolls upright.

## 1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F (21 deg C)] **<Insert temperature>** or more than [95 deg F (35 deg C)] **<Insert temperature>**, in spaces to receive floor coverings during the following time periods:
  1. 72 hours before installation.



2. During installation.
  3. 72 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] **<Insert temperature>** or more than [95 deg F (35 deg C)] **<Insert temperature>**.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 72 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

#### 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.; **<Insert product name or designation>**.
  2. Forbo Flooring, Inc.; **<Insert product name or designation>**.
  3. Tarkett Inc.; **<Insert product name or designation>**.
  4. **<Insert manufacturer's name; product name or designation>**.
  5. or approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Linoleum shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 LINOLEUM FLOOR COVERING <Insert drawing designation>

- A. Floor Tile: ASTM F 2195, [**Type I, linoleum floor tile with fibrous backing**] [**Type II, linoleum floor tile with special backing**] [**Type III, linoleum floor tile without backing**].
- Nominal Floor Tile Size: [**Manufacturer's standard**] [**12 by 12 inches** (300 by 300 mm)] [**18 by 18 inches** (460 by 460 mm)] [**20 by 20 inches** (500 by 500 mm)] [**24 by 24 inches** (600 by 600 mm)] <Insert size>.
- B. Sheet Flooring: ASTM F 2034, [**Type I, linoleum sheet with backing**] [**Type III, linoleum sheet with special backing**].
- Roll Size: In manufacturer's standard length by not less than **78 inches** (1980 mm) wide.
- C. Seaming Method: [**Standard**] [**Heat welded**].
- D. Thickness: [**0.08 inch** (2.0 mm)] [**0.10 inch** (2.5 mm)] [**0.13 inch** (3.2 mm)] [**0.16 inch** (4.0 mm)] [**0.18 inch** (4.5 mm)] <Insert thickness>.
- E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.
- Adhesives shall have a VOC content of not more than [**50**] <Insert value> g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Heat-Welding Bead: Solid-strand product of linoleum floor covering manufacturer.
- [**As selected by DEN Project Manager from manufacturer's full range to contrast with linoleum floor covering**] [**Match linoleum floor covering**] <Insert color>.
- D. Integral-Flash-Cove-Base Accessories:
- Cove Strip: **1-inch** (25.4-mm) radius provided or approved by manufacturer.

2. Cove-Base Cap Strip: [**Square metal, vinyl, or rubber cap**] <Insert requirements> provided or approved by manufacturer.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  4. Moisture Testing: Perform tests recommended by manufacturer[ **and as follows**]. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] <Insert emission> in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum [**75 percent**] <Insert acceptable percentage> relative humidity level measurement.
    - c. Submit test results to DEN Project Manager.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
  - 1. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

### 3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.
- E. Install floor coverings on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of floor covering installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

### 3.4 LINOLEUM FLOOR TILE INSTALLATION

- A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay floor tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] <Insert requirements>.
- B. Match floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent floor tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**] <Insert requirements>.

### 3.5 LINOLEUM SHEET FLOORING INSTALLATION

- A. Unroll sheet floorings and allow them to stabilize before cutting and fitting.
- B. Lay out sheet floorings as follows:
  1. Maintain uniformity of floor covering direction.
  2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** (152 mm) away from parallel joints in floor covering substrates.
  3. Match edges of floor coverings for color shading at seams.
  4. Avoid cross seams.
  5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).
- C. Integral-Flash-Cove Base: Cove linoleum floor covering [**6 inches** (152 mm)] [**dimension indicated**] <Insert dimension> up vertical surfaces. Support floor covering at horizontal and vertical junction with cove strip. Butt at top against cap strip.

### 3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
  1. Remove adhesive and other blemishes from exposed surfaces.
  2. Sweep and vacuum surfaces thoroughly.
  3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.
  1. Apply [**two**] [**three**] <Insert requirement> coat(s).
- E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096516.13

## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Solid vinyl floor tile.
2. Rubber floor tile.
3. Vinyl composition floor tile.
4. Resilient terrazzo floor tile.

- B. Related Sections:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
2. Section 096516 "Resilient Sheet Flooring" for resilient sheet floor coverings.
3. Section 096516.13 "Linoleum Flooring" for linoleum floor coverings.
4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

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

#### 1.3 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For **[adhesives] [sealants] [and] [chemical-bonding compounds]**, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives **[and chemical-bonding compounds]**, documentation including printed statement of VOC content.

3. Product Data for Credit IEQ 4.3: For resilient tile flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  4. Laboratory Test Reports for Credit IEQ 4: For **[flooring system] [adhesives] [sealants] [and] [chemical-bonding compounds]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
1. Show details of special patterns.
- D. Samples for Initial Selection: For each type of floor tile indicated.
- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.
1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **[9 inches (230 mm)] <Insert dimension>** long, of each color required.
- F. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of **[6-by-9-inch (150-by-230-mm)] <Insert size>** Sample applied to a rigid backing and prepared by Installer for this Project.
- G. Product Schedule: For floor tile. **[ Use same designations indicated on Drawings.]**
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.
  - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 MATERIALS MAINTENANCE SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Floor Tile: Furnish 1 box for every **[50] <Insert number>** boxes or fraction thereof, of each type, color, and pattern of floor tile installed.



## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation[ **and seaming method**] indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups for floor tile including[ **resilient base and**] accessories.
    - a. Size: Minimum **100 sq. ft.** (9.3 sq. m) for each type, color, and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** (10 deg C) or more than **90 deg F** (32 deg C). Store floor tiles on flat surfaces.

## 1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [**70 deg F** (21 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [**55 deg F** (13 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.

- E. Install floor tile after other finishing operations, including painting, have been completed.

#### 1.10 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

#### 2.2 SOLID VINYL FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Altro Group; <Insert product name or designation>.
  2. Amtico Studio (The), Amtico International Inc.; <Insert product name or designation>.
  3. Armstrong World Industries, Inc.; <Insert product name or designation>.
  4. Burke Mercer Flooring Products, Division of Burke Industries Inc.; <Insert product name or designation>.
  5. Estrie Products International, American Biltrite (Canada) Ltd.; <Insert product name or designation>.
  6. Flexco; <Insert product name or designation>.
  7. Gemtec Inc.; <Insert product name or designation>.
  8. Gerflor, Architectural Floor Systems, Inc.; <Insert product name or designation>.
  9. Johnsonite; <Insert product name or designation>.
  10. Polyflor, Ltd., Distributed by Gerbert Limited; <Insert product name or designation>.
  11. Roppe Corporation, USA; <Insert product name or designation>.
  12. Tarkett, Inc.; <Insert product name or designation>.
  13. TOLI International; <Insert product name or designation>.
  14. VPI, LLC, Floor Products Division; <Insert product name or designation>.
  15. <Insert manufacturer's name; product name or designation>.
  16. or approved equal.

- B. Tile Standard: ASTM F 1700.
1. Class: **[As indicated by product designations] [Class I, monolithic vinyl tile] [Class II, surface-decorated vinyl tile] [Class III, printed film vinyl tile].**
  2. Type: **[Type A, smooth surface] [Type B, embossed surface].**
- C. Thickness: **[0.080 inch (2.0 mm)] [0.100 inch (2.5 mm)] [0.120 inch (3.0 mm)] [0.125 inch (3.2 mm)] <Insert thickness>.**
- D. Size: **[12 by 12 inches (305 by 305 mm)] [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [36 by 36 inches (914 by 914 mm)] [3 by 36 inches (76 by 914 mm)] <Insert size>.**
- E. Seaming Method: **[Heat welded] [Chemically bonded] [Standard] <Insert requirements>.**
- F. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**

### 2.3 RUBBER FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Burke Mercer Flooring Products, Division of Burke Industries Inc.; **<Insert product name or designation>.**
  2. Endura Rubber Flooring, a division of Burke Industries Inc.; **<Insert product name or designation>.**
  3. Estrie Products International, American Biltrite (Canada) Ltd.; **<Insert product name or designation>.**
  4. Flexco; **<Insert product name or designation>.**
  5. Johnsonite; **<Insert product name or designation>.**
  6. Mondo Rubber International, Inc.; **<Insert product name or designation>.**
  7. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; **<Insert product name or designation>.**
  8. PRF USA Inc.; **<Insert product name or designation>.**
  9. R.C.A. Rubber Company (The); **<Insert product name or designation>.**
  10. Roppe Corporation, USA; **<Insert product name or designation>.**
  11. **<Insert manufacturer's name; product name or designation>.**
  12. or approved equal.
- B. Tile Standard: ASTM F 1344, **[Class I-A, homogeneous rubber tile, solid color] [Class I-B, homogeneous rubber tile, through mottled] [Class II-A, laminated rubber tile, solid-color wear layer] [Class II-B, laminated rubber tile, mottled wear layer].**
- C. Hardness: **[Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240] [Manufacturer's standard hardness].**

- D. Wearing Surface: **[Smooth]** **[Textured]** **[Molded pattern]**.
  - 1. Molded-Pattern Figure: **[Raised discs]** **[Raised squares]** **<Insert pattern>**.
- E. Thickness: **[0.125 inch (3.2 mm)]** **<Insert thickness>**.
- F. Size: **[12 by 12 inches (305 by 305 mm)]** **[24 by 24 inches (610 by 610 mm)]** **<Insert size>**.
- G. Seaming Method: **[Heat welded]** **[Chemically bonded]** **[Standard]** **<Insert requirements>**.
- H. Colors and Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.

#### 2.4 VINYL COMPOSITION FLOOR TILE **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. AB ColorPlus, American Biltrite (Canada) Ltd.; **<Insert product name or designation>**.
  - 2. Armstrong World Industries, Inc.; **<Insert product name or designation>**.
  - 3. Congoleum Corporation; **<Insert product name or designation>**.
  - 4. Mannington Mills, Inc.; **<Insert product name or designation>**.
  - 5. Tarkett, Inc.; **<Insert product name or designation>**.
  - 6. Vinylasa Tile, Distributed by American Tile Inc.; **<Insert product name or designation>**.
  - 7. **<Insert manufacturer's name; product name or designation>**.
  - 8. or approved equal.
- B. Tile Standard: ASTM F 1066, **[Class 1, solid-color tile]** **[Class 2, through-pattern tile]** **[Class 3, surface-pattern tile]**.
- C. Wearing Surface: **[Smooth]** **[Embossed]**.
- D. Thickness: **[0.125 inch (3.2 mm)]** **<Insert thickness>**.
- E. Size: **12 by 12 inches (305 by 305 mm)**.
- F. Colors and Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.

#### 2.5 RESILIENT TERRAZZO FLOOR TILE **<Insert drawing designation>**

- A. Resilient Terrazzo Floor Tile: Marble or granite chips embedded in flexible, thermoset-polyester-resin matrix; electrically nonconductive and chemical, oil, and

corrosion resistive, with smooth wearing surface and manufacturer's standard factory-applied, protective urethane coating.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Fritz Industries; **<Insert product name or designation>**.
  - b. **<Insert manufacturer's name; product name or designation>**.
  - c. or approved equal.

B. Thickness: **[1/8 inch (3.0 mm)] [3/16 inch (4.8 mm)]**.

C. Size: **12 by 12 inches** (305 by 305 mm).

D. Performance Characteristics:

1. Compressive Strength: **2900 to 5000 psi** (20 to 34.5 MPa), ASTM C 109/C 109M or ASTM D 695.
2. Abrasion Resistance: Maximum 0.0196 cubic centimeters volume loss, ASTM F 510, Taber abrader, S-39 wheels, at 500 cycles with 1000-gram load.
3. Static Load Limit: **0.0007-inch** (0.0177-mm) maximum indentation, ASTM F 970 at **125 lb** (57 kg).
4. Resin Matrix Hardness: Not less than 78, as measured using Shore, Type D durometer per ASTM D 2240.

E. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.

## 2.6 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
  - b. Rubber Floor Adhesives: Not more than 60 g/L.
  - c. Terrazzo Floor Tile Adhesives: Not more than **[65] <Insert value>** g/L.
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
  - a. Color: **[As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile] [Match floor tile] <Insert color>**.
2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
  - a. Chemical-bonding compound shall have a VOC content of **[350] [510] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - b. Chemical-bonding compound shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.
- E. Joint Sealant for Resilient Terrazzo Floor Tile: Silicone sealant of type and grade as recommended in writing by manufacturer to suit resilient terrazzo floor tile.
  1. Sealant shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  3. Joint-Sealant Color: **[White] [As selected by DEN Project Manager from manufacturer's full range to match floor tile] [Match floor tile] <Insert color>**.
- F. Sealers and Finish Coats for Resilient Terrazzo Floor Tile: Premium-type products as recommended by manufacturer for resilient terrazzo floor tile.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 4. Moisture Testing: Perform tests recommended by manufacturer[ **and as follows**]. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75%] **<Insert acceptable percentage>** relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] **<Insert requirements>**.

- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**].
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and doorframes.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
  - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
  - 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.



- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply [**one**] [**two**] [**three**] <Insert requirements> coat(s).
- E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at doorframes, and at other joints and penetrations.
- F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
  - 1. Sealer: Apply two base coats of liquid sealer.
  - 2. Finish: Apply [**two**] [**three**] <Insert requirements> coats of liquid floor finish.
- G. Cover floor tile until Substantial Completion.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096519

## SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Poured-in-place Portland cement terrazzo flooring[ **and base**].
- 2. Poured-in-place rustic terrazzo flooring.
- 3. Precast terrazzo units.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

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

#### 1.3 DEFINITIONS

- A. Aggregate: Marble chips[ **or other types of aggregate**].

#### 1.4 PREINSTALLATION MEETINGS

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

- 1. Review methods and procedures related to terrazzo including, but not limited to, the following:

- a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
- b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Review special terrazzo designs and patterns.
- d. Review procedures for coping with unfavorable forecasted weather conditions.

e. <Insert agenda items>.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
  2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
  3. Product Data for Credit IEQ 4.3: For sealers, documentation including printed statement of VOC content.
  4. Product Data for Credit IEQ 4.3: For terrazzo flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  5. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [flooring system]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
1. Divider strips.
  2. Control-joint strips.
  3. Expansion-joint strips.
  4. Accessory strips.
  5. Abrasive strips.
  6. Stair treads, risers, and landings.
  7. Precast terrazzo jointing and edge configurations.
  8. Terrazzo patterns.
  9. **<Insert requirements>**.
- D. Samples: For each exposed product and for each color and texture specified, **[6 inches (150 mm)] <Insert dimension>** in size.
- E. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.
- F. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and

aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:

1. Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
2. Precast Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
3. Accessories: [6-inch- (150-mm-)] <Insert dimension> long Samples of each exposed strip item required.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product, from manufacturer.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is a contractor member of NTMA.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum **100 sq. ft.** (9 sq. m) of typical poured-in-place flooring condition for each color and pattern **[in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>**.
    - b. Include **[base] [first three stair treads] <Insert item>**.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

## 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Maintain temperature above 50 deg F (10 deg C) for 48 hours before and during terrazzo installation.
- B. Weather Limitations: Proceed with rustic terrazzo installation only when forecasted weather conditions permit work to be performed according to NTMA's written recommendations and temperatures remain above 45 deg F (7.2 deg C).
- C. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- D. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- E. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- F. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

## 1.11 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.

- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 PORTLAND CEMENT TERRAZZO

- A. Portland Cement Terrazzo System **<Insert designation>**: [**Sand cushion**] [**Bonded**] [**Monolithic**].

1. Underbed: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for component proportions and mixing.
2. Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.
  - a. Terrazzo Topping Thickness: [**As indicated**] **<Insert dimension>**.
  - b. Formulated Mix Color and Pattern: [**As selected by DEN Project Manager from NTMA standard-terrazzo plates**] [**As selected by DEN Project Manager from NTMA Venetian-terrazzo plates**] **<Insert NTMA color plate designation>**.
  - c. Custom Mix Color and Pattern: [**Match DEN Project Manager's sample**] [**Match existing**] **<Insert custom design-mix attributes>**.

- B. Materials:

1. Portland Cement: ASTM C 150, Type 1.
  - a. Color for Exposed Matrix: [**As required by mix indicated**] [**White**] [**Gray**] **<Insert requirements>**.
2. Water: Potable.
3. Sand: ASTM C 33/C 33M.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
  - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131[ **and ASTM C 535**].
  - b. 24-Hour Absorption Rate: Less than 0.75 percent.
  - c. Dust Content: Less than 1.0 percent by weight.
  - d. Recycled Content of Portland Cement Terrazzo Flooring: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
6. Bonding Agent: Neat Portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

7. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire **2 by 2 inches** (51 by 51 mm) by **0.062 inch** (1.57 mm) in diameter, complying with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
8. Isolation Membrane: Polyethylene sheeting, ASTM D 2103, Type 13300, **4 mils** (0.1 mm) thick; or unperforated asphalt felt, ASTM D 226, Type I (No. 15).

## 2.3 RUSTIC TERRAZZO

### A. Rustic Terrazzo System <Insert designation>: **[Bonded] [Monolithic]**.

1. Underbed: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for component proportions and mixing.
2. Terrazzo Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.
  - a. Terrazzo Topping Thickness: **[As indicated] <Insert dimension>**.
  - b. Formulated Mix Color and Pattern: **[As selected by DEN Project Manager from NTMA rustic-terrazzo plates] <Insert NTMA color plate designation>**.
  - c. Custom Mix Color and Pattern: **[Match DEN Project Manager's sample] [Match existing] <Insert custom design-mix attributes>**.

### B. Materials:

1. Portland Cement: ASTM C 150, Type 1.
  - a. Color for Exposed Matrix: **[As required by mix indicated] <Insert requirements>**.
2. Water: Potable.
3. Sand: ASTM C 33/C 33M.
4. Aggregates: As required for mix indicated, sizes comply with NTMA gradation standards and a 0.25 percent maximum 24-hour absorption rate, and aggregates contain no deleterious or foreign matter.
  - a. Recycled Content of Rustic Terrazzo Flooring: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight and weather, and compatible with matrix binder.
6. Air-Entraining Agent: Complies with NTMA's written recommendations and supplier recommendations for intended use.
7. Underbed Bonding Agent: Neat Portland cement.
8. Topping Bonding Agent: Neat Portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

## 2.4 PRECAST TERRAZZO

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Precast Terrazzo Enterprises, Inc.
  2. Romoco Precast Terrazzo Products.
  3. Wausau Tile, Inc.; Terra Paving Products Division.
  4. **<Insert manufacturer's name>**.
  5. or approved equal.
- B. Precast Terrazzo Base **<Insert designation>**: Minimum **3/4-inch-** (19-mm-) thick, reinforced, Portland cement terrazzo units cast in maximum lengths possible, but not less than **36 inches** (900 mm). Comply with NTMA's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.
1. Type: **[As indicated] [Coved with minimum 3/4-inch (19-mm) radius] [Straight] [Splayed] <Insert requirements>**.
  2. Top Edge: **[Straight, unfinished] [Beveled with polished top surface] [Radius edge with polished top surface] <Insert requirements>**.
  3. Metal Toe Strip: **[Zinc] [Brass]**.
  4. Outside Corner Units: With finished returned edges at outside corner.
  5. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.
- C. Precast Terrazzo Units **<Insert designation>**: Minimum **[3/4-inch- (19-mm-)] <Insert dimension>** thick, reinforced, Portland cement terrazzo units. Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to **1/8-inch** (3.2-mm) radius.
1. Tiles.
  2. Planks.
  3. Stair treads[ **and landings**].
  4. Thresholds.
  5. Sills.
  6. Benches.
  7. Planters.
  8. Countertops.
  9. Shower bases.
  10. **<Insert item>**.
  11. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.



## 2.5 STRIP MATERIALS

- A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **<Insert requirements>**.
  2. Depth: **[As indicated]** **[3/4 inch (19 mm)]** **[1-1/4 inches (32 mm)]** **[2 inches (51 mm)]** **<Insert dimension>**.
  3. Width: **[As indicated]** **[0.05 inch (1.27 mm)]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **<Insert dimension>**.
- B. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Base-Section Material: **[As indicated]** **[White-zinc alloy]** **[Galvanized steel]** **<Insert requirements>**.
  2. Top-Section Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **[Plastic, in color selected from full range of industry colors]** **<Insert requirements>**.
  3. Depth: **[As indicated]** **[3/4 inch (19 mm)]** **[1-1/4 inches (32 mm)]** **[2 inches (51 mm)]** **<Insert dimension>**.
  4. Top-Section Width: **[As indicated]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **[1/2 inch (12.7 mm)]** **<Insert dimension>**.
- C. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.
1. Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **[Plastic, in color selected from full range of industry colors]** **<Insert requirements>**.
  2. Top-Section Width: **[As indicated]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **[3/8 inch (9.5 mm)]** **[1/2 inch (12.7 mm)]** **<Insert dimension>**.
- D. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- E. Expansion-Joint Strips: **[Brass]** **[Plastic strips in color selected from full range of industry colors]**, with removable zip-strip top for installing sealant; **[in width indicated]** **[minimum 1/2 inch (12.7 mm) wide]** **<Insert width>**.
- F. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
  2. Edge-bead strips for exposed edges of terrazzo.
  3. Nosings for terrazzo stair treads and landings.
  4. **<Insert requirements>**.

- G. Abrasive Strips: [**Three-line**] [**Two-line**] [**One-line**] [**Abrasive nosing strip and two-line**] <Insert requirements> abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: [**1/2 inch** (12.7 mm)] <Insert dimension>.
  2. Depth: As required by terrazzo thickness.
  3. Length: [**4 inches** (100 mm) **less than stair width**] [**As indicated**] <Insert dimension>.
  4. Color: [**As selected by DEN Project Manager from full range of industry colors**] <Insert requirements>.

## 2.6 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Recommended by manufacturer for this use.
1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Anchoring Devices:
1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
  2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; or cork; [**in width indicated**] [**minimum 1/2 inch** (12.7 mm) **wide**] <Insert dimension>.
- D. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
- E. Rustic Terrazzo Cleaner: Solution of muriatic acid and water for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  2. Acid-Base Properties: With pH factor between 7 and 10.

3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Rustic Terrazzo: Use solvent acrylic-type sealer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
  1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.
- B. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
  1. Moisture Testing: Perform tests indicated below.
    - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.
      - 1) Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
    - b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative-humidity-level measurement.
    - c. Test Method: Test for moisture content by [method recommended in writing by terrazzo manufacturer] <Insert test method>. Proceed with installation only after substrates pass testing.

- C. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
  - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.3 INSTALLATION, GENERAL

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Installation Tolerance: Limit variation in terrazzo surface from level to [1/4 inch in 10 feet (6.4 mm in 3 m)] **<Insert dimensions>**; noncumulative.
- C. Rustic Terrazzo: Install isolation and expansion material where abutting adjacent construction and directly above substrate expansion joints.
- D. Underbed:
  - 1. Comply with NTMA's "Terrazzo Specifications and Design Guide" for underbed installation.
  - 2. Cover entire surface to receive terrazzo with dusting of sand.
  - 3. Install isolation membrane over sand, overlapping ends and edges a minimum of **3 inches** (75 mm).
  - 4. Install welded-wire reinforcement, overlapping at edges and ends at least two squares. [ **Stop mesh a minimum of 1 inch** (25 mm) **short of expansion joints.** ]
  - 5. Place underbed and screed to elevation indicated below finished floor elevation.
- E. Strip Materials:
  - 1. Divider and Control-Joint Strips:
    - a. Locate divider strips [**over each edge of steel beams and girders**] [**centered over steel beams and joists**] [**directly over control joints, breaks, and saw cuts in concrete slabs**] [**in locations indicated**] **<Insert requirements>**.
    - b. Install control-joint strips [**back to back and directly above concrete-slab control joints**] [**in locations indicated**] **<Insert requirements>**.
    - c. Install control-joint strips with [1/4-inch (6.4-mm)] **<Insert dimension>** gap between strips, and install sealant in gap.
    - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
  - 2. Expansion-Joint Strips: Form expansion joints using divider strips and install directly above concrete-slab expansion joints.
  - 3. Accessory Strips: Install as required to provide a complete installation.
  - 4. Abrasive Strips: Install with surface of abrasive strip positioned [1/16 inch (1.6 mm)] **<Insert dimension>** higher than terrazzo surface.

### 3.4 POURED-IN-PLACE TERRAZZO INSTALLATION

- A. Pour in place and seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Cure and finish Portland cement terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
- B. Grinding: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

### 3.5 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with **[cement grout matching precast terrazzo matrix]** **[joint sealant]** <Insert requirements>.

### 3.6 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by DEN Project Manager.

### 3.7 CLEANING AND PROTECTION

- A. Terrazzo Cleaning:
  - 1. Remove grinding dust from installation and adjacent areas.
  - 2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Rustic Terrazzo Cleaning: Clean surfaces with 1:10 solution of muriatic acid in water. Legally contain and dispose of runoff from cleaning operations. Rinse surfaces with water and allow them to dry thoroughly.
- C. Sealing:
  - 1. Seal surfaces according to NTMA's written recommendations.
  - 2. Apply sealer according to sealer manufacturer's written instructions.
- D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096613

## SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Thin-set, epoxy-resin terrazzo flooring[ **and base**].
- 2. Precast epoxy-resin terrazzo units.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.
- 2. Section 096723 "Resinous Flooring" for decorative resinous flooring systems applied as self-leveling slurries or as troweled or screeded mortars.
- 3. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 DEFINITIONS

- A. Aggregate: Marble chips[ **or other types of aggregate**].

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
  - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
    - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - c. Review special terrazzo designs and patterns.
    - d. **<Insert agenda items>**.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
  2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
  3. Product Data for Credit IEQ 4.3: For sealers, documentation including printed statement of VOC content.
  4. Product Data for Credit IEQ 4.3: For terrazzo flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  5. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [flooring system]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
1. Divider strips.
  2. Control-joint strips.
  3. Accessory strips.
  4. Abrasive strips.
  5. Stair treads, risers, and landings.
  6. Precast terrazzo jointing and edge configurations.
  7. Terrazzo patterns.
  8. **<Insert requirements>**.
- D. Samples: For each exposed product and for each color and texture specified, **[6 inches (150 mm)] <Insert dimension>** in size.
- E. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.
- F. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:
1. Terrazzo: **[6-inch- (150-mm-)] <Insert dimension>** square Samples.



2. Precast Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
3. Accessories: [6-inch- (150-mm-)] <Insert dimension> long Samples of each exposed strip item required.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product, from manufacturer.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Engage an installer who is a contractor member of NTMA.
  2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring[ and base] condition for each color and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.
    - b. Include [base] [first three stair treads] <Insert item>.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

#### 1.11 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo **<Insert designation>**: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Crossfield Products Corp., Dex-O-Tex Division; [**Cheminert**] [**Spectrum**] Terrazzo.
    - b. General Polymers Corporation; Terrazzo 1100.
    - c. Key Resin Company; Key Epoxy Terrazzo.
    - d. Master Terrazzo Technologies LLC; Morricite.
    - e. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
    - f. TEC Specialty Construction Brands, Inc.; Tuff-Lite Epoxy Terrazzo.
    - g. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
    - h. **<Insert manufacturer's name; product name or designation>**.
    - i. or approved equal.
  - 2. Thickness: [**1/4 inch (6.4 mm)**] [**3/8 inch (9.5 mm)**] [**As indicated**] **<Insert dimension>** nominal.
  - 3. Formulated Mix Color and Pattern: [**As selected by DEN Project Manager from full range of industry colors**] [**As selected by DEN Project Manager from NTMA standard-terrazzo plates**] [**As selected by DEN Project Manager from NTMA thin-set terrazzo plates**] **<Insert manufacturer's or NTMA's color plate designation>**.
  - 4. Custom Mix Color and Pattern: [**Match DEN Project Manager's sample**] [**Match existing**] **<Insert custom design-mix attributes>**.
- B. Materials:
  - 1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
    - a. Reinforcement: Fiberglass scrim.
  - 2. Primer: [**Manufacturer's product recommended for substrate and use indicated**] **<Insert requirements>**.
  - 3. Epoxy-Resin Matrix: [**Manufacturer's standard recommended for use indicated**] **<Insert requirements>** and in color required for mix indicated.

- a. Physical Properties without Aggregates:
  - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
  - 2) Minimum Tensile Strength: **3000 psi** (20.7 MPa) per ASTM D 638 for a **2-inch** (51-mm) specimen made using a "C" die per ASTM D 412.
  - 3) Minimum Compressive Strength: **10,000 psi** (6.9 MPa) per ASTM D 695, Specimen B cylinder.
  - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
    - a) Distilled water.
    - b) Mineral water.
    - c) Isopropanol.
    - d) Ethanol.
    - e) 0.025 percent detergent solution.
    - f) 1.0 percent soap solution.
    - g) 10 percent sodium hydroxide.
    - h) 10 percent hydrochloric acid.
    - i) 30 percent sulfuric acid.
    - j) 5 percent acetic acid.
- b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
  - 1) Flammability: Self-extinguishing, maximum extent of burning **1/4 inch** (6.35 mm) per ASTM D 635.
  - 2) Thermal Coefficient of Linear Expansion: **0.0025 inch/inch per deg F** (0.0025 mm/mm per 0.5556 deg C) for temperature range of **minus 12 to plus 140 deg F** (minus 24 to plus 60 deg C) per ASTM D 696.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
  - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
  - b. 24-Hour Absorption Rate: Less than 0.75 percent.
  - c. Dust Content: Less than 1.0 percent by weight.
  - d. Recycled Content of Epoxy-Resin Terrazzo: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
5. Finishing Grout: Resin based.

## 2.3 PRECAST EPOXY-RESIN TERRAZZO

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

1. Precast Terrazzo Enterprises, Inc.
  2. Romoco Precast Terrazzo Products.
  3. Wausau Tile, Inc.; Terra Paving Products Division.
  4. **<Insert manufacturer's name>**.
  5. or approved equal.
- B. Precast Terrazzo Base **<Insert designation>**: Minimum **3/4-inch-** (19-mm-) thick, reinforced portland cement terrazzo units cast in maximum lengths possible, but not less than **36 inches** (900 mm). Comply with NTMA's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.
1. Type: **[As indicated] [Coved with minimum 3/4-inch (19-mm) radius] [Straight] [Splayed] <Insert requirements>**.
  2. Top Edge: **[Straight, unfinished] [Beveled with polished top surface] [Radius edge with polished top surface] <Insert requirements>**.
  3. Metal Toe Strip: **[Zinc] [Brass]**.
  4. Outside Corner Units: With finished returned edges at outside corner.
  5. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.
- C. Precast Terrazzo Units **<Insert designation>**: Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to **1/8-inch** (3.2-mm) radius.
1. Tiles.
  2. Planks.
  3. Stair treads[ **and landings**].
  4. Thresholds.
  5. Sills.
  6. Benches.
  7. Planters.
  8. Countertops.
  9. Shower bases.
  10. **<Insert item>**.
  11. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.

## 2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle, **1/4 inch** (6.4 mm) deep.
1. Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors] <Insert requirements>**.
  2. Top Width: **[As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] <Insert dimension>**.

- B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
1. Bottom-Section Material: **[As indicated] [Galvanized steel] [Matching top-section material] <Insert requirements>**.
  2. Top-Section Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors] <Insert requirements>**.
  3. Top-Section Width: **[As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)] <Insert dimension>**.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
  2. Edge-bead strips for exposed edges of terrazzo.
  3. Nosings for terrazzo stair treads and landings.
  4. **<Insert requirements>**.
- E. Abrasive Strips: **[Three-line] [Two-line] [One-line] [Abrasive nosing strip and two-line] <Insert requirements>** abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: **[1/2 inch (12.7 mm)] <Insert dimension>**.
  2. Depth: As required by terrazzo thickness.
  3. Length: **[4 inches (100 mm) less than stair width] [As indicated] <Insert dimension>**.
  4. Color: **[As selected by DEN Project Manager from full range of industry colors] <Insert requirements>**.

## 2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.
  2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: **[Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated] [Acrylic] [Urethane] [Chemical-resistant epoxy] <Insert requirements>.**
1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  2. Acid-Base Properties: With pH factor between 7 and 10.
  3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
  1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants

incompatible with terrazzo.

- a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
- b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
- c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests indicated below.

- a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.

1) Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.

- b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative-humidity-level measurement.
- c. Test Method: Test for moisture content by [method recommended in writing by terrazzo manufacturer] <Insert test method>. Proceed with installation only after substrates pass testing.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
- C. Installation Tolerance: Limit variation in terrazzo surface from level to [1/4 inch in 10 feet (6.4 mm in 3 m)] <Insert dimensions>; noncumulative.



- D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
- E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- F. Flexible Reinforcing Membrane:
  - 1. Prepare and prefill substrate cracks with membrane material.
  - 2. Install membrane **[at substrate cracks] [to produce full substrate coverage]** in areas to receive terrazzo.
  - 3. Reinforce membrane with fiberglass scrim.
  - 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
- G. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
- H. Strip Materials:
  - 1. Divider and Control-Joint Strips:
    - a. Locate divider strips **[in locations indicated]** <Insert requirements>.
    - b. Install control-joint strips **[back to back directly above concrete-slab control joints] [in locations indicated]** <Insert requirements>.
    - c. Install control-joint strips with **[1/4-inch (6.4-mm)]** <Insert dimension> gap between strips, and install sealant in gap.
    - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
  - 2. Accessory Strips: Install **[as required to provide a complete installation] [in locations indicated]** <Insert requirements>.
  - 3. Abrasive Strips: Install with surface of abrasive strip positioned **[1/16 inch (1.6 mm)]** <Insert dimension> higher than terrazzo surface.

### 3.4 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or not properly finished.
- C. Seal joints between units with **[joint compound matching precast terrazzo matrix] [joint sealant]** <Insert requirements>.

### 3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or

repair panels according to NTMA's written recommendations, as approved by DEN Project Manager.

### 3.6 CLEANING AND PROTECTION

#### A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

#### B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

#### C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096623

## SECTION 096723 - RESINOUS FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Decorative resinous flooring systems.
  - 2. Industrial resinous flooring systems.
  - 3. High-performance resinous flooring systems.
- B. Related Sections:
  - 1. Section 079200 "Joint Sealants" for sealants installed at joints in resinous flooring systems.
  - 2. Section 096623 "Resinous Matrix Terrazzo Flooring" for thin-set, resinous matrix terrazzo.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.2: For liquid-applied flooring components, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit IEQ 4: For flooring systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of exposed finish required.
- D. Samples for Verification: For each resinous flooring system required, **6 inches** (150 mm) square, applied to a rigid backing by Installer for this Project.
- E. Product Schedule: For resinous flooring.[ **Use same designations indicated on Drawings.**]

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
  - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on **48-inch-** (1200-mm-) square floor area selected by DEN Project Manager.
    - a. Include **48-inch** (1200-mm) length of integral cove base with inside[ **and outside**] corner.

2. Simulate finished lighting conditions for DEN Project Manager's review of mockups.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

#### 1.9 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Hi-Tech Flooring Company.
  2. Arizona Polymer Flooring, Inc.
  3. Atlas Minerals & Chemicals, Inc.; Polymer Flooring Division.
  4. BASF Construction Chemicals, Inc.; BASF Building Systems.
  5. ChemMasters.
  6. CornerStone Flooring & Linings.
  7. Crawford Laboratories Inc.; Florock.

8. Crossfield Products Corp.; Dex-O-Tex.
9. Crown Polymers, LLC.
10. Delta Polymers, Inc.
11. DUDICK Inc.
12. Dur-A-Flex, Inc.
13. Epoxy Systems, Inc.
14. ICS Garland Inc.
15. International Coatings Inc.
16. ITW Resin Technologies.
17. Key Resin Company.
18. Marbelite International Corp.
19. Micor Company, Inc.
20. NEOGARD; Division of JONES-BLAIR.
21. Northern Industries, Inc.
22. Nox-Crete Products Group.
23. Pacific Polymers, Inc.
24. Palma, Inc.
25. POLY-CARB, Inc.
26. Polymerica, Incorporated.
27. PolySpec.
28. PPG Industries, Inc.
29. Protective Floorings & Linings, Inc.; a division of Chesterton.
30. RBC Industries, Inc.
31. ROCK-TRED Corporation.
32. Rust-Oleum Corporation.
33. Sauereisen.
34. Sherwin-Williams Company; General Polymers.
35. Specifier Products Inc.; Stonecarpet.
36. Stonhard, Inc.
37. Tamms Industries, Inc.; a division of The Euclid Chemical Company.
38. Tnemec Company, Inc.
39. Tufco International Inc.
40. Valspar Flooring.
41. **<Insert manufacturer's name>**.
42. or approved equal.

## 2.2 MATERIALS

- A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 DECORATIVE RESINOUS FLOORING[ <RF-#>]

A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor[ **and integral cove base**].

B. System Characteristics:

1. Color and Pattern: [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated by product designation listed above**] [**Match DEN Project Manager's sample**] <Insert description>.
2. Wearing Surface: [**Textured for slip resistance**] [**Orange-peel texture**] [**Smooth**] [**Manufacturer's standard wearing surface**] <Insert description>.
3. Overall System Thickness: [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] <Insert thickness>.
4. Federal Agency Approvals: [**USDA**] [**FDA**] approved for food-processing environments.

C. Body Coats:

1. Resin: [**Epoxy**] <Insert resin>.
2. Formulation Description: [**100 percent solids**] [**High solids**] [**Water based**] <Insert requirements>.
3. Application Method: [**Self-leveling slurry with broadcast aggregates**] [**Self-leveling slurry**] [**Troweled or screeded**].
  - a. Thickness of Coats: [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] <Insert thickness>.
  - b. Number of Coats: [**One**] [**Two**] <Insert number>.
4. Aggregates: [**Manufacturer's standard**] [**Colored quartz (ceramic-coated silica)**] [**Vinyl flakes**] [**Granite**] [**Natural silica**] <Insert requirements>.

D. Topcoat: Sealing or finish coats.

1. Resin: [**Epoxy**] [**Urethane**] [**Vinyl ester**] <Insert resin>.
2. Formulation Description: [**100 percent solids**] [**High solids**] [**Water based**] <Insert requirements>.
3. Type: [**Clear**] [**Pigmented**] <Insert description>.
4. Finish: [**Matte**] [**Gloss**].
5. Number of Coats: [**One**] [**Two**] <Insert number>.

E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: <Insert value> per ASTM C 579.
2. Tensile Strength: <Insert value> per ASTM C 307.
3. Flexural Modulus of Elasticity: <Insert value> per ASTM C 580.
4. Water Absorption: <Insert value> per ASTM C 413.

5. Coefficient of Thermal Expansion: **<Insert value>** per ASTM C 531.
  6. Indentation: **<Insert number>** percent maximum per MIL-D-3134.
  7. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch** (1.6-mm) permanent indentation per MIL-D-3134.
  8. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch** (1.6 mm) per MIL-D-3134.
  9. Abrasion Resistance: **<Insert value>** maximum weight loss per ASTM D 4060.
  10. Flammability: Self-extinguishing per ASTM D 635.
  11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
  12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
  13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.
- F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:
1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.

#### 2.4 INDUSTRIAL RESINOUS FLOORING[ **<RF-#>**]

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor[ **and integral cove base**].
- B. System Characteristics:
1. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by product designation listed above] [Match DEN Project Manager's sample] <Insert description>**.
  2. Wearing Surface: **[Textured for slip resistance] [Orange-peel texture] [Smooth] [Manufacturer's standard wearing surface] <Insert description>**.
  3. Overall System Thickness: **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>**.
  4. Federal Agency Approvals: **[USDA] [FDA]** approved for food-processing environments.
- C. Body Coats:
1. Resin: **[Epoxy] [Urethane] [Vinyl ester] <Insert resin>**.
  2. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.
  3. Application Method: **[Self-leveling slurry with broadcast aggregates] [Self-leveling slurry] [Troweled or screeded]**.
    - a. Thickness of Coats: **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>**.
    - b. Number of Coats: **[One] [Two] <Insert number>**.



4. Aggregates: **[Manufacturer's standard] [Colored quartz (ceramic-coated silica)] [Vinyl flakes] [Granite] [Natural silica] <Insert requirements>**.
- D. Topcoat: Sealing or finish coats.
1. Resin: **[Epoxy] [Urethane] [Vinyl ester] <Insert resin>**.
  2. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.
  3. Type: **[Clear] [Pigmented] <Insert description>**.
  4. Finish: **[Matte] [Gloss]**.
  5. Number of Coats: **[One] [Two] <Insert number>**.
- E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: **<Insert value>** per ASTM C 579.
  2. Tensile Strength: **<Insert value>** per ASTM C 307.
  3. Flexural Modulus of Elasticity: **<Insert value>** per ASTM C 580.
  4. Water Absorption: **<Insert value>** per ASTM C 413.
  5. Coefficient of Thermal Expansion: **<Insert value>** per ASTM C 531.
  6. Indentation: **<Insert number>** percent maximum per MIL-D-3134.
  7. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm)** permanent indentation per MIL-D-3134.
  8. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm)** per MIL-D-3134.
  9. Abrasion Resistance: **<Insert value>** maximum weight loss per ASTM D 4060.
  10. Flammability: Self-extinguishing per ASTM D 635.
  11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
  12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
  13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.
- F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:
1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.
- 2.5 HIGH-PERFORMANCE RESINOUS FLOORING[ **<RF-#>**]
- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor[ **and integral cove base**].
- B. System Characteristics:
1. Color and Pattern: **[As selected by DEN Project Manager from**

- manufacturer's full range** [As indicated by product designation listed above] [Match DEN Project Manager's sample] <Insert description>.
2. Wearing Surface: [Textured for slip resistance] [Orange-peel texture] [Smooth] [Manufacturer's standard wearing surface] <Insert description>.
  3. Overall System Thickness: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>.
  4. Federal Agency Approvals: [USDA] [FDA] approved for food-processing environments.

C. Body Coats:

1. Resin: [Epoxy] [Epoxy novolac] [Urethane] [Vinyl ester] [Methyl methacrylate] <Insert resin>.
2. Formulation Description: [100 percent solids] [High solids] [Water based] <Insert requirements>.
3. Application Method: [Self-leveling slurry with broadcast aggregates] [Self-leveling slurry] [Troweled or screeded].
  - a. Thickness of Coats: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>.
  - b. Number of Coats: [One] [Two] <Insert number>.
4. Aggregates: [Manufacturer's standard] [Colored quartz (ceramic-coated silica)] [Vinyl flakes] [Granite] [Natural silica] <Insert requirements>.

D. Topcoat: Sealing or finish coats.

1. Resin: [Epoxy] [Epoxy novolac] [Urethane] [Vinyl ester] [Methyl methacrylate] <Insert resin>.
2. Formulation Description: [100 percent solids] [High solids] [Water based] <Insert requirements>.
3. Type: [Clear] [Pigmented] <Insert description>.
4. Finish: [Matte] [Gloss].
5. Number of Coats: [One] [Two] <Insert number>.

E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: <Insert value> per ASTM C 579.
2. Tensile Strength: <Insert value> per ASTM C 307.
3. Flexural Modulus of Elasticity: <Insert value> per ASTM C 580.
4. Water Absorption: <Insert value> per ASTM C 413.
5. Coefficient of Thermal Expansion: <Insert value> per ASTM C 531.
6. Indentation: <Insert number> percent maximum per MIL-D-3134.
7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
9. Abrasion Resistance: <Insert value> maximum weight loss per ASTM D 4060.

10. Flammability: Self-extinguishing per ASTM D 635.
11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.

F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:

1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.

## 2.6 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

1. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.

B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.

1. Formulation Description: **[100 percent solids] [High solids] <Insert requirements>**.

C. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.

1. Formulation Description: **[100 percent solids] [High solids] <Insert requirements>**.

- a. Provide fiberglass scrim embedded in reinforcing membrane.

D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
  2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert emission rate> of slab area in 24 hours.
    - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
    - c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative humidity level measurement.
  4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

### 3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
1. Apply waterproofing membrane to integral cove base substrates.
- D. Apply reinforcing membrane to **[substrate cracks]** **[entire substrate surface]**.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: **[4 inches (100 mm)]** **<Insert dimension>** high.
- F. Apply self-leveling slurry body coats in thickness indicated for flooring system.
1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- H. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- I. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

### 3.3 FIELD QUALITY CONTROL

- A. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per **1000 sq. ft. (92.9 sq. m)** of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

#### 3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

### **PART 4 - MEASUREMENT**

#### 4.1 METHOD OF MEASUREMENT

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

### **PART 5 - PAYMENT**

#### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096723

## SECTION 096813 - TILE CARPETING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes modular, [**fusion-bonded**] [**tufted**] <Insert construction> carpet tile.
- B. Related Requirements:
  - 1. Section 024119 "Selective Structure Demolition" for removing existing floor coverings.
  - 2. [**Section 096513 "Resilient Base and Accessories"**] [**Section 096519 "Resilient Tile Flooring"**] for resilient wall base and accessories installed with carpet tile.
  - 3. Section 096816 "Sheet Carpeting."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.
  - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.
    - d. <Insert agenda items>.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written data on all physical characteristics, durability, static performance, fire-test response characteristics, static performance, and

- fade resistance, and fire-test response characteristics.
- 2. Include installation recommendations for each type of substrate.
- 3. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

- 1. Product Data for Credit EQ 4.3:
  - a. For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
  - b. For installation adhesive, documentation including printed statement of VOC content.
- 2. LEED Requirements:
  - a. Products supplied under this section shall meet the requirements of LEED for:
  - b. Low Emitting Materials Carpet.
  - c. Low Emitting Adhesives, Sealants, and Primers.
  - d. Rapidly Renewable Materials.
  - e. Regional Materials.
  - f. Recycled Content.
  - g. Construction Waste Management.

C. Shop Drawings: Show the following:

- 1. Existing flooring materials to be removed.
- 2. Existing flooring materials to remain.
- 3. Columns, doorways, enclosing walls, or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
- 4. Carpet tile type, color, and dye lot.
- 5. Type of subfloor.
- 6. Type of installation.
- 7. Pattern of installation.
- 8. Pattern type, location, direction, and starting point.
- 9. Pile direction.
- 10. Seam locations, types, and methods.
- 11. Type of cushion.
- 12. Type, color, and location of insets and borders.
- 13. Type, color, and location of edge, transition, and other accessory strips.
- 14. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Prepare Samples from the same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

- 1. Carpet Tile: Full-size Sample.
- 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.



- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for **[Bronze, 28 to 36]** **[Silver, 37 to 51]** **[Gold, 52 to 70]** points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to **[five (5)]** **<Insert number>** percent of amount installed for each type indicated, but not less than **10 sq. yd.** (8.3 sq. m).

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the **[Commercial II]** **[Master II]** **<Insert description>** certification level.
- B. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.

- C. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockups at locations and in sizes shown on Drawings, and if not indicated, as directed by DEN Project Manager.
  - 2. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
  - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 4. Obtain DEN Project Manager's approval of mockups before start of final unit of Work.
  - 5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- C. Store materials on-site in original undamaged packages, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

#### 1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer, and not less than the following requirements:
  - 1. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55oF (12.7oC).
  - 2. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and phydron paper is applied.

- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

#### 1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, **[dimensional stability,] [excess static discharge,] [loss of tuft bind strength,]** loss of face fiber, **<Insert failure characteristic>** and delamination.
  3. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.
- B. CONSTRUCTION WASTE MANAGEMENT
1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. **<Insert manufacturer's name; product name or designation>**.
  2. or approved equal.
- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- C. Pattern: **[Match DEN Project Manager's samples] <Insert pattern>**.
- D. Fiber Content: **[100 percent nylon 6, 6] [100 percent nylon 6] [100 percent polypropylene] [100 percent wool] [80 percent wool; 20 percent nylon 6, 6] [80 percent wool; 20 percent nylon 6] <Insert percentage>**.
- E. Fiber Type: **<Insert proprietary fiber type>**.
- F. Pile Characteristic: **[Level-loop] [Cut] [Cut-and-loop] <Insert construction>** pile.
- G. Yarn Twist: **<Insert TPI (TPCM)>**.

- H. Yarn Count: <Insert count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet tile[ according to ASTM D 6859].
- K. Stitches: <Insert stitches per inch (mm)>.
- L. Gage: <Insert ends per inch (mm)>.
- M. Surface Pile Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet tile.
- O. Primary Backing/Backcoating: [Manufacturer's standard composite materials] [PVC] [Fiberglass-reinforced PVC] [Fiberglass-reinforced amorphous resin] [Reinforced polyurethane composite cushion] [Reinforced polyurethane composite] [Reinforced thermoplastic copolymer] <Insert specific primary backing materials; consult manufacturers>.
- P. Secondary Backing: [Manufacturer's standard material] <Insert specific secondary backing material>.
- Q. Backing System: <Insert proprietary name>.
- R. Size: [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [18 by 36 inches (457 by 914 mm)] [36 by 36 inches (914 by 914 mm)] <Insert dimensions>.
- S. Applied Soil-Resistance Treatment: [Manufacturer's standard material] <Insert treatment>.
- T. Antimicrobial Treatment: [Manufacturer's standard material] <Insert treatment>.
- U. Performance Characteristics: As follows:
1. Appearance Retention Rating: [Moderate traffic, 2.5] [Heavy traffic, 3.0] [Severe traffic, 3.5] <Insert number> minimum according to ASTM D 7330.
  2. Critical Radiant Flux Classification: Not less than [0.45 W/sq. cm] [0.22 W/sq. cm].
  3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
  4. Tuft Bind: Not less than [3 lbf (13 N)] [5 lbf (22 N)] [6.2 lbf (28 N)] [8 lbf (36 N)] [10 lbf (45 N)] <Insert value> according to ASTM D 1335.
  5. Delamination: Not less than [3.5 lbf/in. (15 N/mm)] [4 lbf/in. (18 N/mm)] <Insert value> according to ASTM D 3936.
  6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
  7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
  8. Resistance to Insects: Comply with AATCC 24.
  9. Noise Reduction Coefficient (NRC): <Insert NRC> according to ASTM C 423.
  10. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC

165.

11. Colorfastness to Light: Not less than 4 after [40] [60] <Insert number> AFU (AATCC fading units) according to AATCC 16, Option E.
12. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
13. Electrostatic Propensity: Less than [3.5] [2] <Insert number> kV according to AATCC 134.
14. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
15. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 INSTALLATION ACCESSORIES

- A. Concrete-Slab Primer: Nonstaining type as recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer.**]
- B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
  1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Metal Edge/Transition Strips: Extruded aluminum with [mill] <Insert finish> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- E. Extruded or molded vinyl or rubber, colors selected by DEN Project Manager from standard colors available within the industry.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with

requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

- B. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the carpet manufacturer.
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
  3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. For wood subfloors, verify the following:
1. Underlayment over subfloor complies with requirements specified in Section 061000 "Rough Carpentry."
  2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- E. For metal subfloors, verify the following:
1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- F. For painted subfloors, verify the following:
1. Perform bond test recommended in writing by adhesive manufacturer.
- G. For raised access flooring systems, verify the following:
1. Access floor substrate is compatible with carpet tile and adhesive if any.
  2. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than [1/8 inch (3 mm)] **<Insert dimension>**, protrusions more than 1/32 inch (0.8 mm), and substances that may interfere with adhesive bond or show through surface.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with carpet manufacturer's installation recommendations to prepare substrates indicated to receive carpet installation.
- B. Examine surfaces to receive carpeting for holes, debris, or other defects that will

- adversely affect the execution and quality of Work. Do not proceed until conditions are satisfactory.
- C. Allow concrete surfaces to cure a minimum of 30 days.
  - D. Do not install carpeting until masonry **[and drywall] [and plastering] [is] [are]** complete.
  - E. Install carpeting prior to installation of demountable or movable partitions, fixtures, or telephone and electrical pedestal floor outlets.
  - F. Install carpet within allowable temperature range stated by manufacturer.
  - G. Level subfloor within 1/4 inch in 10 feet (6 mm in 3 m), noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
  - H. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the carpet manufacturer.
  - I. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.
  - J. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.
  - K. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by carpet manufacturer.
  - L. Resilient-Flooring Substrate Preparation: Replace missing pieces of existing resilient flooring or patch to level. Cut out peaked seams and fill with latex underlayment as recommended by manufacturer. Repair depressions with material recommended by carpet manufacturer..
  - M. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
  - N. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider and protrusions more than **1/32 inch (0.8 mm)** unless more stringent requirements are required by manufacturer's written instructions.
  - O. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
  - P. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand

aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

- Q. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: **[As recommended in writing by carpet tile manufacturer]** **[Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive]** **[Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive]** **[Free lay; install carpet tiles without adhesive]**.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Where demountable partitions or other items are indicated for installation on top of finished carpet floor, install carpet before installation of these items.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  2. Remove yarns that protrude from carpet tile surface.
  3. Vacuum carpet tile using commercial machine with face-beater element.
  4. Vacuum carpet, and clean if necessary, just prior to acceptance by Owner.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."



- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096813

## SECTION 096816 - SHEET CARPETING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Tufted carpet.
2. Woven carpet.
3. Carpet cushion.
4. **<Insert type>**

- B. Related Requirements:

1. Section 024119 "Selective Structure Demolition" for removing existing floor coverings.
2. **[Section 096519 "Resilient Tile Flooring"] [Section 096513 "Resilient Base and Accessories"]** for resilient wall base and accessories installed with carpet.
3. Section 096813 "Tile Carpeting."

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

#### 1.3 PREINSTALLATION MEETINGS

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

1. Review methods and procedures related to carpet installation including, but not limited to, the following:
  - a. Review delivery, storage, and handling procedures.
  - b. Review ambient conditions and ventilation procedures.
  - c. Review subfloor preparation procedures.
  - d. **<Insert agenda items>**.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:
1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, fire-test response characteristics, static performance, and fade resistance.
  2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.
  3. Submit methods of installation for each type of substrate.
  4. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit EQ 4.3:
    - a. For carpet, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
    - b. For carpet cushion, documentation indicating compliance with testing and product requirements of CRI's "Green Label" program.
    - c. For installation adhesive, including printed statement of VOC content.
  2. LEED Requirements:
    - a. Products supplied under this section shall meet the requirements of LEED for:
    - b. Low Emitting Materials Carpet.
    - c. Low Emitting Adhesives, Sealants, and Primers.
    - d. Rapidly Renewable Materials.
    - e. Regional Materials.
    - f. Recycled Content.
    - g. Construction Waste Management.
- C. Shop Drawings: Show the following:
1. Existing flooring materials to be removed.
  2. Existing flooring materials to remain.
  3. Columns, doorways, enclosing walls, or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  4. Carpet type, color, and dye lot.
  5. Type of cushion.
  6. Locations where dye lot changes occur.
  7. Seam locations, types, and methods.
  8. Type of subfloor.
  9. Type of installation.
  10. Pattern type, repeat size, location, direction, and starting point.
  11. Pile direction.
  12. Type, color, and location of insets and borders.
  13. Type, color, and location of edge, transition, and other accessory strips.

14. Transition details to other flooring materials.
  15. Type of carpet cushion.
- D. Samples: For each of the following products and for each color and texture required. Prepare Samples from the same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: **12-inch-** (300-mm-) square Sample.
  2. Exposed Edge, Transition, and Other Accessory Stripping: **12-inch-** (300-mm-) long Samples.
  3. Carpet Cushion: **6-inch-** (150-mm-) square Sample.
  4. Carpet Seam: **6-inch** (150-mm) Sample.
  5. Mitered Carpet Border Seam: **12-inch-** (300-mm-) square Sample. Show carpet pattern alignment.
- E. Product Schedule: For carpet[ **and carpet cushion**]. Use same designations indicated on Drawings.
- F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for [**Bronze, 28 to 36**] [**Silver, 37 to 51**] [**Gold, 52 to 70**] points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
  - B. Product Test Reports: For carpet[ **and carpet cushion**], for tests performed by a qualified testing agency.
  - C. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
    1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
    2. Precautions for cleaning materials and methods that could be detrimental to carpet[ **and carpet cushion**].
    3. Methods for maintaining carpet cushion, including manufacturer's recommended frequency for maintaining carpet.
  - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet: Full-width rolls equal to **[five (5)] <Insert number>** percent of amount installed for each type indicated, but not less than **10 sq. yd.** (8.3 sq. m).
  2. Deliver usable scraps of carpet to Owner's designated storage space, properly packaged and identified. Usable scraps are defined to include roll ends of less than 9'0" length, and pieces of more than 3 square foot area and more than 8 inches wide. Dispose of smaller pieces as "construction waste."

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the **[Commercial II] [Master II] <Insert description>** certification level.
- B. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.
- C. Fire-Test-Response Ratings: Where indicated, provide carpet[ **and carpet cushion**] identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.
1. Provide carpet with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting agency.
    - a. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
    - b. Flame Spread: 25 or less per ASTM E84.
    - c. Smoke Developed: 450 or less per ASTM E84.
  2. Carpet Cushion Fire-Test-Response Characteristics: Provide carpet cushion with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify carpet cushion with appropriate markings of applicable testing and inspecting agency.
    - a. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
    - b. Flame Spread: 25 or less per ASTM E84.
    - c. Smoke Developed: 450 or less per ASTM E84.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings, and if not indicated, as directed by DEN Project Manager.
2. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain DEN Project Manager's approval of mockups before start of final unit of Work.
5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- C. Store materials on-site in original undamaged packages, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

#### 1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet[ **and carpet cushion**] until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet[ **and carpet cushion**] over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer, and not less than the following requirements:
  1. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55 deg F (12.7 deg C).
  2. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and phydron paper is applied.

- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

#### 1.11 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, **[loss of tuft bind strength,] [excess static discharge,] <Insert failure characteristic>** and delamination.
3. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.

- B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.

#### 1.12 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 TUFTED CARPET <Insert designation>

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

1. **<Insert manufacturer's name; product name or designation>**.
2. or approved equal.

- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

- C. Pattern: **[Match DEN Project Manager's samples]** <Insert pattern>.
- D. Fiber Content: **[100 percent nylon 6, 6] [100 percent nylon 6] [100 percent polypropylene]** <Insert fiber and content by percentage>.
- E. Fiber Type: <Insert proprietary fiber type>.
- F. Pile Characteristic: **[Level-loop] [Cut] [Cut-and-loop] [Multilevel-loop] [Level tip shear] [Random shear] [Frieze] [Sculptured]** <Insert characteristic> pile.
- G. Yarn Twist: <Insert twist in TPI (TPCM)>.
- H. Yarn Count: <Insert yarn count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet[ per ASTM D 6859].
- K. Stitches: <Insert stitches per inch (mm)>.
- L. Gage: <Insert gage in ends per inch (mm)>.
- M. Face Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet.
- O. Primary Backing: **[Manufacturer's standard material] [Woven polypropylene] [Nonwoven, polypropylene or polyester]** <Insert specific primary backing material>.
- P. Secondary Backing: **[Manufacturer's standard material] [Woven polypropylene] [Nonwoven, polypropylene or polyester] [Woven jute] [Fiberglass]** <Insert specific secondary backing material>.
- Q. Backcoating: **[Manufacturer's standard material] [SBR latex] [PVC] [Thermoplastic copolymer]** <Insert backcoating; consult manufacturers>.
- R. Backing System: <Insert proprietary name>.
- S. Width: **[12 feet (3.7 m)] [6 feet (1.8 m)] [13.5 feet (4.1 m)] [15 feet (4.6 m)]** <Insert dimension>.
- T. Applied Soil-Resistance Treatment: **[Manufacturer's standard material]** <Insert treatment>.
- U. Antimicrobial Treatment: **[Manufacturer's standard material]** <Insert treatment>.
- V. Performance Characteristics: As follows:
1. Appearance Retention Rating: **[Moderate traffic, 2.5] [Heavy traffic, 3.0] [Severe traffic, 3.5]** <Insert number> minimum per ASTM D 7330.



2. Critical Radiant Flux Classification: Not less than **[0.45 W/sq. cm]** **[0.22 W/sq. cm]**.
3. Dry Breaking Strength: Not less than **100 lbf** (445 N) per ASTM D 2646.
4. Tuft Bind: Not less than **[3 lbf (13 N)] [5 lbf (22 N)] [6.2 lbf (28 N)] [8 lbf (36 N)] [10 lbf (45 N)]** **<Insert value>** per ASTM D 1335.
5. Delamination: Not less than **[2.5 lbf/in. (12 N/mm)] [3.5 lbf/in. (15 N/mm)] [4 lbf/in. (18 N/mm)]** **<Insert value>** per ASTM D 3936.
6. Resistance to Insects: Comply with AATCC 24.
7. Noise Reduction Coefficient (NRC): **<Insert NRC>** per ASTM C 423.
8. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
9. Colorfastness to Light: Not less than 4 after **[40] [60]** **<Insert number>** AFU (AATCC fading units) per AATCC 16, Option E.
10. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
11. Electrostatic Propensity: Less than **[3.5] [2]** **<Insert number>** kV per AATCC 134.
12. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
13. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 WOVEN CARPET **<Insert designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. **<Insert manufacturer's name; product name or designation>**.
  2. or approved equal.
- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
- C. Pattern: **[Match DEN Project Manager's samples]** **<Insert pattern>**.
- D. Fiber Content: **[100 percent wool] [80 percent wool; 20 percent nylon 6, 6] [80 percent wool; 20 percent nylon 6]** **<Insert fiber and content by percentage>**.
  1. Document that **[5 to 20] [85 to 100]** **<Insert number>** percent of the material feedstock for carpet is composed of biobased or recycled materials according to ANSI/NSF 140.
- E. Face Construction: **[Axminster] [Wilton] [Velvet]** **<Insert construction>**.
- F. Pile Characteristic: **[Level-loop] [Cut] [Cut-and-loop]** pile.
- G. Yarn Twist: **<Insert twist in TPI (TPCM)>**.

- H. Yarn Count: <Insert yarn count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet[ per ASTM D 6859].
- K. Rows: <Insert number of lengthwise tufts per inch (mm)>.
- L. Pitch: <Insert number of rows in 27 inches (686 mm)>.
- M. Face Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet.
- O. Backing: [Manufacturer's standard.] [As follows:]
1. Chain Warp: <Insert material>.
  2. Stuffer Warp: <Insert material>.
  3. Shot or Fill Weft: <Insert material>.
  4. Backcoating: <Insert backcoating>.
- P. Applied Soil-Resistance Treatment: [Manufacturer's standard material] <Insert treatment>.
- Q. Antimicrobial Treatment: [Manufacturer's standard material] <Insert treatment>.
- R. Performance Characteristics: As follows:
1. Appearance Retention Rating: [Moderate traffic, 2.5] [Heavy traffic, 3.0] [Severe traffic, 3.5] <Insert number> minimum per ASTM D 7330.
  2. Critical Radiant Flux Classification: Not less than [0.45 W/sq. cm] [0.22 W/sq. cm].
  3. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
  4. Resistance to Insects: Comply with AATCC 24.
  5. Noise Reduction Coefficient (NRC): <Insert NRC> per ASTM C 423.
  6. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
  7. Colorfastness to Light: Not less than 4 after [40] [60] <Insert number> AFU (AATCC fading units) per AATCC 16, Option E.
  8. Electrostatic Propensity: Less than [3.5] [2] <Insert number> kV per AATCC 134.
  9. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
  10. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 CARPET CUSHION <Insert designation>

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

1. <Insert manufacturers' names>.
2. or approved equal.

B. Traffic Classification: CCC [**Class I, moderate**] [**Class II, heavy**] [**Class III, extra-heavy**] traffic.

C. Fiber Cushion: [**Rubberized hair, mothproofed and sterilized**] [**Rubberized jute, mothproofed and sterilized**] [**Synthetic**] [**Resinated, recycled textile**].

1. Weight: <Insert oz./sq. yd. (g/sq. m)>.
2. Thickness: <Insert inches (mm)> plus 5 percent maximum.
3. Density: <Insert lb/cu. ft. (kg/cu. m)>.

D. Rubber Cushion: [**Flat**] [**Rippled waffle**] [**Textured flat**] [**Reinforced**].

1. Weight: <Insert oz./sq. yd. (g/sq. m)>.
2. Thickness: <Insert inches (mm)> plus 5 percent maximum.
3. Compression Resistance: <Insert lb/sq. in. (kg/sq. mm)> at [**25**] [**65**] percent per ASTM D 3676.
4. Density: <Insert lb/cu. ft. (kg/cu. m)>.

E. Polyurethane-Foam Cushion: [**Grafted prime**] [**Densified**] [**Bonded**] [**Mechanically frothed**].

1. Compression Force Deflection at 65 Percent: <Insert lb/sq. in. (kg/sq. mm) of **polymer density**> per ASTM D 3574.
2. Thickness: <Insert inches (mm)>.
3. Density: <Insert lb/cu. ft. (kg/cu. m)>.

F. Performance Characteristics: As follows:

1. Critical Radiant Flux Classification: Not less than [**0.45 W/sq. cm**] [**0.22 W/sq. cm**].
2. Noise Reduction Coefficient (NRC): <Insert **NRC**> per ASTM C 423.
3. Emissions: Provide carpet cushion that complies with testing and product requirements of CRI's "Green Label" program.
4. Emissions: Provide carpet cushion that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 INSTALLATION ACCESSORIES

A. Concrete-Slab Primer: Nonstaining type as recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].

- B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet[ **cushion**] manufacturer.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by [**carpet manufacturer**] [**carpet and carpet cushion manufacturers**].
  - 1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Use adhesives that comply with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.
- E. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- F. Metal Edge/Transition Strips: Extruded aluminum with [**mill**] <**Insert finish**> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- G. Extruded or molded vinyl or rubber, colors selected by DEN Project Manager from standard colors available within the industry.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the [**Carpet manufacturer**] [**Carpet cushion manufacturer**].
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and

- dryness characteristics by performing bond and moisture tests recommended by carpet[ **cushion**] manufacturer.
2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet.
  3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. For wood subfloors, verify the following:
1. Underlayment over subfloor complies with requirements specified in Section 061000 "Rough Carpentry."
  2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with carpet manufacturer's installation recommendations to prepare substrates indicated to receive carpet installation.
- B. Examine surfaces to receive carpeting for holes, debris, or other defects that will adversely affect the execution and quality of Work. Do not proceed until conditions are satisfactory.
- C. Allow concrete surfaces to cure a minimum of 30 days.
- D. Do not install carpeting until masonry [**and drywall**] [**and plastering**] [**is**] [**are**] complete.
- E. Install carpeting prior to installation of demountable or movable partitions, fixtures, or telephone and electrical pedestal floor outlets.
- F. Install carpet within allowable temperature range stated by manufacturer.
- G. Level subfloor within 1/4 inch in 10 feet (6 mm in 3 m), noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
- H. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the following:
  1. [**Carpet manufacturer.**] [**Carpet cushion manufacturer**].
- I. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.
- J. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.
- K. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to

manufacturer's directions, where recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].

- L. Resilient-Flooring Substrate Preparation: Replace missing pieces of existing resilient flooring or patch to level. Cut out peaked seams and fill with latex underlayment as recommended by manufacturer. Repair depressions with material recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].
- M. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- N. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch** (3 mm) wide or wider, and protrusions more than **1/32 inch** (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- O. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet [**cushion**] manufacturer.
- P. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 INSTALLATION

- A. Comply with CRI 104 and [**carpet manufacturer's**] [**carpet and carpet cushion manufacturers**] written installation instructions for the following:
  - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
  - 2. Double-Glue-Down Installation: Comply with CRI 104, Section 10, "Double-Glue-Down Installation."
  - 3. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 11, "Attached-Cushion Installations."
  - 4. Preapplied Adhesive Installation: Comply with CRI 104, Section 11.4, "Pre-Applied Adhesive Systems (Peel and Stick)."
  - 5. Hook-and-Loop Installation: Comply with CRI 104, Section 11.5, "Hook and Loop Technology."
  - 6. Stretch-in Installation: Comply with CRI 104, Section 12, "Stretch-in Installations."
  - 7. Stair Installation: Comply with CRI 104, Section 13, "Carpet on Stairs" for [**stretch-in**] [**glue-down**] installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.

- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Where demountable partitions or other items are indicated for installation on top of finished carpet floor, install carpet before installation of these items.
- F. Extend carpet into toe spaces, door reveals, closet, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.
- I. Comply with carpet cushion manufacturer's written recommendations. [**Install carpet cushion seams at 90-degree angle with carpet seams.**]

### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
  - 4. Vacuum carpet, and clean if necessary, just prior to acceptance by Owner.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer [**and carpet cushion manufacturer**] [**and carpet adhesive manufacturer**] [**and carpet cushion and adhesive manufacturers**].

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096816



## SECTION 096900 - ACCESS FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Access-flooring panels.
- 2. Understructure.
- 3. Floor panel coverings.

- B. Related Requirements:

- 1. Section 233600 "Air Terminal Units" for variable-air-volume diffusers.
- 2. Section 260526 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

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

#### 1.3 ALLOWANCES

- A. Cutouts in floor panels are part of **<Insert name of allowance>**.
- B. Service outlets are part of **<Insert name of allowance>**.

#### 1.4 UNIT PRICES

- A. Work of this Section is affected by **[cutouts in floor panels] [and] [service outlets]**.

#### 1.5 COORDINATION

- A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.
- B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

## 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Review connection with mechanical and electrical systems.
  2. Review requirements related to sealing the plenum.
  3. Review procedures for keeping underfloor space clean.

## 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For pedestal-installation adhesives, documentation including printed statement of VOC content.
  2. Product Data for Credit IEQ 4.3: For pedestal-installation adhesives, documentation including printed statement of VOC content.
  3. Product Data for Credit IEQ 4.3: For floor panel coverings, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
  4. Product Data for Credit IEQ 4.4: For particleboard used in steel-encapsulated, wood-core panels, documentation indicating that product contains no urea formaldehyde.
  5. Laboratory Test Reports for Credit IEQ 4: For **[access-flooring system with integral finishes] [pedestal-installation adhesives] [and] [particleboard used in steel-encapsulated, wood-core panels]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.
1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.
- D. Samples:
1. Floor Covering: Full-size units for each color and texture specified.
  2. Exposed Metal Accessories: Approximately **10 inches** (250 mm) in length.
  3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.
- E. Samples for Initial Selection: For each type of product and exposed finish.

- F. Samples for Verification: For the following products:
1. Floor Covering: Full-size units.
  2. Exposed Metal Accessories: Approximately **10 inches** (250 mm) in length.
  3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of access-flooring system.
- C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.
- D. Seismic Design Calculations: For seismic design of access-flooring systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Preconstruction Test Reports: For preconstruction adhesive field test.

#### 1.9 CLOSEOUT SUBMITTALS

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

#### 1.10 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Flooring Panels: **<Insert number>**.
  2. Pedestals: **<Insert number>**.
  3. Stringers: **<Insert number>**.

#### 1.11 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical access-flooring assembly as shown on Drawings. Size to be an area no fewer than **[five]** <Insert number> floor panels in length by **[five]** <Insert number> floor panels in width.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.12 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage]** a qualified testing agency to perform preconstruction testing on field mockups.

1. <Insert sizes and configurations of assemblies>.
2. Use personnel, materials, and methods of construction that will be used at Project site.
3. Notify DEN Project Manager **[seven]** <Insert number> days in advance of the dates and times when laboratory mockups will be tested.

- B. Preconstruction Adhesive Field Test: Before installing pedestals, field test their adhesion to subfloor surfaces by doing the following:

1. In areas representative of each subfloor surface, set typical pedestal assemblies in same adhesive and use methods required for the completed Work.
2. Allow test installation to cure for manufacturer's recommended cure time, with a pressure of **25 lbf** (111 N) applied vertically to pedestals during this period.
3. After curing, apply lateral load against a straight steel bar inserted **2 inches** (51 mm) into pedestal stems. Measure the force needed to cause adhesive failure of pedestal base.
4. Remove and discard failed pedestals, and clean pedestals of adhered residue.
5. Proceed with installation only after tests show compliance with performance requirement specified for pedestals' capability to resist overturning moment.

#### 1.13 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, **[subfloor has been sealed,]** ambient temperature is between **50 and 90 deg F** (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

#### 1.14 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** **<Insert requirement>**.
- B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in Cisca's "Recommended Test Procedures for Access Floors":
1. Concentrated Loads: **[900 lbf (4003 N)] [1000 lbf (4448 N)] [1250 lbf (5560 N)] [1500 lbf (6672 N)] [2000 lbf (8896 N)] <Insert value>** with the following deflection and permanent set:
    - a. Top-Surface Deflection: **[0.10 inch (2.54 mm)] <Insert dimension>**.
    - b. Permanent Set: **[0.010 inch (0.25 mm)] <Insert dimension>**.
  2. Ultimate Loads: **[1800 lbf (8006 N)] [2000 lbf (8896 N)] [2500 lbf (11 121 N)] [3000 lbf (13 345 N)] [4000 lbf (17 793 N)] <Insert value>**.
  3. Rolling Loads: With local or overall deformation not to exceed **0.040 inch (1.02 mm)**.
    - a. Cisca Wheel 1: 10 passes at **[400 lbf (1779 N)] [500 lbf (2224 N)] [600 lbf (2669 N)] [800 lbf (3559 N)] [1000 lbf (4448 N)] [1200 lbf (5338 N)] [1250 lbf (5560 N)] [2000 lbf (8896 N)] <Insert value>**.
    - b. Cisca Wheel 2: 10,000 passes at **[400 lbf (1779 N)] [500 lbf (2224 N)] [600 lbf (2669 N)] [800 lbf (3559 N)] [1000 lbf (4448 N)] [1250 lbf (5560 N)] [1750 lbf (7784 N)] [2000 lbf (8896 N)] <Insert value>**.
  4. Stringer Load Test: **[75 lbf (334 N)] [225 lbf (1001 N)] [350 lbf (1557 N)] [450 lbf (2002 N)] <Insert value>** at center of span with a permanent set not to exceed **0.010 inch (0.25 mm)**.
  5. Pedestal Axial Load Test: **[5000 lbf (22 240 N)] [6000 lbf (26 690 N)] <Insert value>**.
  6. Pedestal Overturning Moment Test: **[1000 lbf x inches (113 N x meters)] <Insert values>**.
  7. Uniform Load Test: **[200 lbf/sq. ft. (9.6 kPa)] [250 lbf/sq. ft. (12.0 kPa)] [300 lbf/sq. ft. (14.4 kPa)] [400 lbf/sq. ft. (19.2 kPa)] [500 lbf/sq. ft. (23.9 kPa)] <Insert value>** with a maximum top-surface deflection not to exceed **0.040 inch (1.02 mm)** and a permanent set not to exceed **0.010 inch (0.25 mm)**.
  8. Drop Impact Load Test: **[75 lb (34.0 kg)] [100 lb (45.5 kg)] [125 lb (56.7 kg)] [150 lb (68.0 kg)] [175 lb (79.4 kg)] <Insert value>**.
- C. Fire Performance:
1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- a. Flame-Spread Index: **[25] <Insert value>** or less.
  - b. Smoke-Developed Index: **[50] [450] <Insert value>** or less.
2. Combustion Characteristics: ASTM E 136.
- D. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 MANUFACTURERS

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

## 2.3 FLOOR PANELS

- A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.

1. Size: Nominal **[24 by 24 inches (610 by 610 mm)] <Insert dimensions>**.
2. Attachment to Understructure: **[Bolted] [By gravity]**.
3. One-to-One Carpet Tile: Fabricate panels to accept one-to-one carpet tile.

- B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.

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

- a. ASM Modular Systems, Inc.
- b. Bergvik North America, Inc.
- c. Camino Modular Systems, Inc.
- d. Computer Environments, Inc.
- e. Haworth, Inc.
- f. Tate Access Floors, Inc.
- g. **<Insert manufacturer's name>**.
- h. or approved equal.

- C. Wood-Core Steel Panels: Fabricated with **1-inch- (25-mm-) thick particleboard core[, made without urea formaldehyde][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"]** laminated to top and bottom steel face sheets, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish, and with a flame-spread index of 25 or less according

to ASTM E 84. Provide core edges enclosed with upturned, die-formed, bottom-sheet edge or with perimeter steel channel welded to top sheet and welded or bonded to bottom sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASM Modular Systems, Inc.
  - b. Bergvik North America, Inc.
  - c. Camino Modular Systems, Inc.
  - d. Computer Environments, Inc.
  - e. Tate Access Floors, Inc.
  - f. **<Insert manufacturer's name>**.
  - g. or approved equal.
  
- D. Unfilled Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASM Modular Systems, Inc.
    - b. Camino Modular Systems, Inc.
    - c. Computer Environments, Inc.
    - d. Haworth, Inc.
    - e. Tate Access Floors, Inc.
    - f. **<Insert manufacturer's name>**.
    - g. or approved equal.
  
  2. Solid Panels: Flat, solid top surface.
  3. Perforated Panels: Perforated top surface with **[holes] [slots]** of number, spacing, and size standard with manufacturer to produce a nominal open area of **[23] [24] [25] <Insert number>** percent. **[ Provide mechanical dampers with each panel unit.]**
    - a. Quantity: **[As shown on Drawings] <Insert number>**.
    - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.
  
  4. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of **[45] [50] [56] <Insert number>** percent. **[ Provide mechanical dampers with each panel unit.]**
    - a. Quantity: **[As shown on Drawings] <Insert number>**.
    - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.

- E. Exposed-Concrete-Surface Panels: Fabricated with bottom pan that is die formed from metallic-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Haworth, Inc.
    - b. **<Insert manufacturer's name>**.
    - c. or approved equal.
- F. Aluminum Panels: Fabricated from manufacturer's standard aluminum alloy with equivalent strength and corrosion resistance of Alloy UNS No. A03830 or UNS No. A03840 according to ASTM B 85.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASM Modular Systems, Inc.
    - b. Computer Environments, Inc.
    - c. Tate Access Floors, Inc.
    - d. **<Insert manufacturer's name>**.
    - e. or approved equal.
  2. Solid Panels: Flat, solid surface on top and symmetrical crossing ribs on bottom; edge machined after casting to specified tolerances.
  3. Perforated Panels: Perforated top surface with **[holes]** **[slots]** of number, spacing, and size standard with manufacturer to produce a nominal open area of **[16.5]** **<Insert number>** percent. **[ Provide mechanical dampers with each panel unit.]**
    - a. Quantity: **[As shown on Drawings]** **<Insert number>**.
    - b. Finish: **[Manufacturer's standard]** **[To match solid panels]** **<Insert finish>**.
  4. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of **[55]** **<Insert number>** percent. **[ Provide mechanical dampers with each panel unit.]**
    - a. Quantity: **[As shown on Drawings]** **<Insert number>**.
    - b. Finish: **[Manufacturer's standard]** **[To match solid panels]** **<Insert finish>**.
  5. Epoxy Finish: **[Conductive]** epoxy powder coating with a minimum average thickness of **2.5 mils** (0.064 mm) and in color selected from manufacturer's full range.
  6. Plated Finish: Nickel-chrome electrodeposited plating, **0.000005-inch** (0.000127-mm) chrome over **0.0008-inch** (0.02-mm) nickel, without copper or brass strike, to produce complete coverage over significant surfaces with a matte metallic appearance.



## 2.4 UNDERSTRUCTURE

- A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of **[steel]** **[aluminum]**.
1. Provide pedestals designed for use in seismic applications.
  2. Base: Square or circular base with not less than **[16 sq. in. (103 sq. cm)]** **<Insert dimension>** of bearing area.
  3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
  4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than **[2 inches (51 mm)]** **<Insert dimension>** and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
  5. Head: Designed to support the panel system indicated.
    - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
    - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
- B. Stringer Systems: Modular **[steel]** **[aluminum]** stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.
1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

## 2.5 FLOOR PANEL COVERINGS

- A. FloorScore Compliance: Floor panel coverings shall comply with requirements of FloorScore Standard.
- B. High-Pressure Plastic Laminate: Factory applied, NEMA LD 3, High-Wear type, **[Grade HDH]** **[Grade HDM]**; fabricated in one piece to cover each panel face with **[integral trim]** **[applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Formica Corporation.
    - b. Panolam Industries.
    - c. **<Insert manufacturer's name>**.
    - d. or approved equal.
  2. Electrical Resistance: Average no less than 1 megohm and no more than 20,000 megohms when installed floor coverings are surface-to-ground tested according to NFPA 99.

3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- C. Conductive High-Pressure Plastic Laminate: Factory applied, NEMA LD 3, High-Wear type, **[Grade HDH] [Grade HDM]**; fabricated in one piece to cover each panel face with **[integral trim] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Panolam Industries.
    - b. **<Insert manufacturer's name>**.
    - c. or approved equal.
  2. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
  3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- D. Static-Dissipative Vinyl Tile: Factory applied, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face with **[monolithic] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexco, Inc.
    - b. VPI Corporation.
    - c. **<Insert manufacturer's name>**.
    - d. or approved equal.
  2. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
  3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- E. Conductive Vinyl Tile: Factory applied, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face with **[monolithic] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Flexco, Inc.
  - b. VPI Corporation.
  - c. **<Insert manufacturer's name>**.
  - d. or approved equal.
2. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
  3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.

## 2.6 FABRICATION

### A. Fabrication Tolerances:

1. Size: Plus or minus **0.020 inch** (0.50 mm) of required size.
2. Squareness: Plus or minus **0.015 inch** (0.38 mm) between diagonal measurements across top of panel.
3. Flatness: Plus or minus **0.035 inch** (0.89 mm), measured on a diagonal on top of panel.

### B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

### C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

### D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Number, Size, Shape, and Location: **[As indicated.] [As specified in Section 012100 "Allowances" and Section 012200 "Unit Prices."]**
2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange.**[Furnish removable covers for grommets.]**
3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

## 2.7 ACCESSORIES

### A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide **[two] [four]** post-installed **[expansion anchors] [threaded concrete screws]** made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to **[1.5] <Insert number>** times the loads imposed by pedestal overturning moment on fasteners, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- C. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
1. Structural Performance: Cover capable of supporting a **[300-lbf (1334-N)] [800-lbf (3559-N)] [1000-lbf (4448-N)]** concentrated load.
  2. Cover and Box Type: **[Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles] [Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone connectors and signal cables] <Insert type>**.
  3. Location: In center of panel quadrant unless otherwise indicated.
  4. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
  5. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:
    - a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
    - b. Number of Receptacles for Outlet: **[One] [Two] [Four] <Insert number>**.
    - c. Wiring Method: Factory wired for hardwiring in field with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a **[6-inch- (152-mm-)] <Insert dimension>** long pigtail.
    - d. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.
- D. Occupant Adjustable Diffusers: Manufacturer's standard round diffusers, **[4 inches (102 mm)] [8 inches (203 mm)] <Insert dimension>** in diameter, formed from **[aluminum] [polycarbonate plastic]** to produce a removable one-piece unit complete with diffuser, manually adjustable flow regulator, dirt and dust receptacle, trim ring, and underfloor compression mounting ring; precisely fitted in factory-prepared openings of standard field panels and complying with the following requirements:

1. Air-Distribution Characteristics: [100 cfm (47 L/s)] <Insert value> at [0.096-inch (24-Pa)] <Insert value> static pressure and a maximum noise criterion rating of [15] <Insert number>.
  2. Structural Performance: Capable of supporting a [600-lbf (2669-N)] <Insert value> concentrated load.
  3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.
- E. Floor Grilles: Standard load-bearing grilles formed from [aluminum] [polycarbonate plastic] to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, [with adjustable/removable] [without] dampers and complying with the following requirements:
1. Air-Distribution Characteristics: 468 cfm at 0.10-inch wg (221 L/s at 25-Pa) static pressure.
  2. Structural Performance: Capable of supporting a 1000-lbf (4448-N) concentrated load.
  3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.
- F. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet with [4-by-13-inch (102-by-330-mm) rectangular] [3-inch (76-mm) round] [5-inch (127-mm) round] <Insert dimension(s)> usable area for passage of power and signal cables through plenum walls. Frame of [ABS plastic] [aluminum] with passageway consists of intermediate layer of flexible EPDM rubber and interwoven nylon filaments.[ Provide units with plastic cable tray for support of cables and protection of wallboard.]
- G. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.
- H. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with [manufacturer's standard finish] <Insert finish>.
- I. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.
- J. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.
- K. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.
1. Provide railings that comply with structural performance requirements specified in [Section 055213 "Pipe and Tube Railings"] [Section 057300 "Decorative Metal Railings."]
- L. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required[ for each computer room].

- M. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.
  - 2. Verify that concrete floor sealer and finish have been applied and cured.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than **6 inches** (152 mm).
- B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

#### **3.3 INSTALLATION**

- A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
- B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.
- C. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors.
- D. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.
- E. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

- F. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.
  - G. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than **1/8 inch** (3 mm) where panels abut vertical surfaces.
    - 1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.
  - H. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.
  - I. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
    - 1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.
  - J. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
  - K. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
  - L. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.
  - M. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
  - N. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
    - 1. Plus or minus [**1/16 inch** (1.5 mm)] [**1/8 inch** (3 mm)] **<Insert dimension>** in any **10-foot** (3-m) distance.
    - 2. Plus or minus [**1/8 inch** (3 mm)] [**1/4 inch** (6.5 mm)] **<Insert dimension>** from a level plane over entire access-flooring area.
- 3.4 PROTECTION
- A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for [**72**] **<Insert number>** hours after installation to allow pedestal adhesive to set.
  - B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

- C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 096900



## SECTION 097513 - STONE PANELING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes anchored stone paneling for the following interior applications:
  - 1. Wall paneling.
  - 2. Column facing.
  - 3. Units with carving or inscriptions.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for installing concrete inserts for anchoring stone paneling.
  - 2. Section 042000 "Unit Masonry" for installing masonry inserts for anchoring stone paneling.
  - 3. Section 079200 "Joint Sealants" for sealing expansion joints in stone paneling.
  - 4. Section 093033 "Stone Tiling" for stone wall tile.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each[ **variety of stone,**] stone accessory, and manufactured product.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
    - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
  3. Product Data for Credit IEQ 4.1: For sealants, documentation including printed statement of VOC content.
- C. Laboratory Test Reports for Credit IEQ 4.1: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: Show fabrication and installation details for stone paneling system, including dimensions and profiles of stone units.- 1. Show locations and details of joints both within stone paneling system and between stone paneling system and other finish materials.
- 2. Show locations and details of anchors, including locations of supporting construction.
- 3. Show direction of veining, grain, or other directional pattern.
- 4. Include large-scale shaded drawings of [**decorative surfaces**] [**and**] [**inscriptions**].

E. Samples for Initial Selection: For joint materials involving color selection.

F. Samples for Verification:- 1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include [**two**] [**three**] [**four**] [**five**] <Insert number> or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
- 2. For each color of [**grout**] [**pointing mortar**] [**and**] [**sealant**] required.
- 3. For [**carving**] [**and**] [**inscriptions**].

G. Delegated-Design Submittal: For stone paneling assembly.

## 1.5 INFORMATIONAL SUBMITTALS

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

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone paneling to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone paneling similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone paneling.
- C. Installer Qualifications: A firm or individual experienced in installing stone paneling similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockups for the following kinds of stone paneling:
    - a. Typical stone wall paneling, not less than **72 inches** (1800 mm) long by **96 inches** (2400 mm) high.
    - b. Typical stone wainscot paneling, not less than **72 inches** (1800 mm) long by full wainscot height.
    - c. Typical column facing, one complete column.
    - d. Grouting or pointing of joints.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

## 1.9 DELIVERY, STORAGE, AND HANDLING

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

## 1.10 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for seven days after completion.
- B. Field Measurements: Verify dimensions of construction to receive stone paneling by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.11 COORDINATION

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

## 1.12 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[ **each variety of**] stone, [**regardless of finish,** ]from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
  - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
  - 2. Make quarried blocks available for examination by DEN Project Manager.
  - 3. Make stone slabs available for examination by DEN Project Manager.
    - a. DEN Project Manager will select aesthetically acceptable slabs[ **and will indicate aesthetically unacceptable portions of slabs**].
    - b. Segregate slabs selected for use on Project and mark backs indicating approval.
    - c. Mark and photograph aesthetically unacceptable portions of slabs as directed by DEN Project Manager.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone paneling system.
- B. General: Design stone anchors and anchoring systems according to ASTM C 1242.

C. Seismic Performance: Stone paneling system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

1. Component Importance Factor: **[1.5] [1.0]**.

### 2.3 GRANITE <Insert drawing designation>

A. Material Standard: Comply with ASTM C 615.

B. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.

C. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site.

D. Description: Uniform, **[fine] [medium]**-grained, **[white] [pink] [gray] [black]** <Insert color> stone **[without veining]**.

E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
2. or approved equal.

F. Cut: **[Vein] [Fleuri]**.

1. Orientation of Veining: **[Horizontal] [Vertical] [As indicated]**.

G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

H. Finish: **[Polished] [Honed] [Thermal] [As indicated] [Match DEN Project Manager's sample]** <Insert finish>.

I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

### 2.4 LIMESTONE <Insert drawing designation>

A. Material Standard: Comply with ASTM C 568.

1. Classification: **[I Low] [II Medium] [III High]** Density.

B. Regional Materials: Limestone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.

C. Regional Materials: Limestone shall be fabricated within **500 miles (800 km)** of Project site.

- D. Description: [**Dolomitic**] [**Oolitic**] [**Shell**] limestone.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
  2. or approved equal.
- F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
1. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.
- G. Cut: [**Vein**] [**Fleuri**].
1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>** [, **matching standard ILI finish**].
- J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 MARBLE <Insert drawing designation>

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

- F. Cut: [**Vein**] [**Fleuri**].
  - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 QUARTZ-BASED STONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 616, [**Classification I Sandstone**] [**Classification II Quartzitic Sandstone**] [**Classification III Quartzite**] [, except for minimum free silica content].
- B. Regional Materials: Quartz-based stone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Quartz-based stone shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- E. Finish: [**Sand rubbed**] [**Natural cleft**] [**Thermal**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.7 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site.



- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
  - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.8 SLATE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 629, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Slate shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Slate shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[ **and unfading color,**] from clear, sound stock.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
  - 2. or approved equal.
- F. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.9 TRAVERTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].

- B. Regional Materials: Travertine shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
  - C. Regional Materials: Travertine shall be fabricated within **500 miles (800 km)** of Project site.
  - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
    - 2. or approved equal.
  - E. Cut: [**Vein**] [**Fleuri**].
    - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
  - F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
  - G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
  - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>**.
  - I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.10 OTHER STONE <Insert drawing designation>
- A. Material Standards:
    - 1. Maximum Absorption per ASTM C 97/C 97M: **<Insert required value>**.
    - 2. Minimum Compressive Strength per ASTM C 170/C 170M: **<Insert required value>**.
    - 3. Minimum Flexural Strength per ASTM C 880/C 880M: **<Insert required value>**.
  - B. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
  - C. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site.
  - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
    - 2. or approved equal.

- E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

## 2.11 SETTING MATERIALS

- A. Molding Plaster: ASTM C 59/C 59M.
- B. Portland Cement: ASTM C 150, Type I or Type II.
  - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate: ASTM C 144.
- E. Water: Potable.

## 2.12 GROUT

- A. Grout Colors: [**Match stone**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
  - 1. Grout Type: [**Sanded**] [**Unsanded**].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Bostik, Inc.](#)
    - b. [C-Cure.](#)
    - c. [Custom Building Products.](#)
    - d. [DAP Inc.](#)
    - e. [Jamo Inc.](#)
    - f. [Laticrete International, Inc.](#)
    - g. [MAPEI Corporation.](#)
    - h. [Mer-Krete Systems; ParexLahabra, Inc.](#)
    - i. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)

- j. [Southern Grouts & Mortars, Inc.](#)
  - k. [Summitville Tiles, Inc.](#)
  - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
  - m. **<Insert manufacturer's name>**.
  - n. or approved equal.
2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
- a. [Boiardi Products; a QEP company.](#)
  - b. [Bostik, Inc.](#)
  - c. [C-Cure.](#)
  - d. [Custom Building Products.](#)
  - e. [Jamo Inc.](#)
  - f. [Laticrete International, Inc.](#)
  - g. [MAPEI Corporation.](#)
  - h. [Mer-Krete Systems; ParexLahabra, Inc.](#)
  - i. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
  - j. [Summitville Tiles, Inc.](#)
  - k. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
  - l. **<Insert manufacturer's name>**.
  - m. or approved equal.

## 2.13 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Davis Colors; True Tone Mortar Colors.
  - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
  - c. Solomon Colors; SGS Mortar Colors.
  - d. **<Insert manufacturer's name; product name or designation>.**
  - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
    - b. Lafarge North America Inc.; Eaglebond.
    - c. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
    - d. **<Insert manufacturer's name; product name or designation>.**
    - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16** (1.18-mm) sieve.
1. White Aggregates: Natural white sand or ground white stone.
  2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

## 2.14 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.
1. Use mildew-resistant joint sealant at plumbing fixtures and for control and expansion joints in toilet rooms[ **and other wet locations**].
  2. Mildew-Resistant Joint Sealant: [**Mildew resistant, single component, nonsag, neutral curing, silicone**] [**Single component, nonsag, mildew resistant, acid curing, silicone**] **<Insert joint sealant>.**
  3. Joint Sealant: [**Latex**] [**Acrylic based**] [**Butyl rubber based**] [**Single component, nonsag, neutral curing, silicone; Class 25**] **<Insert joint sealant>.**
  4. VOC Content: [**250**] **<Insert value>** g/L.
  5. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

6. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.
- B. Sealant for Filling Kerfs: [**Same sealant used for joints in dimension stone**] [**Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone**] [**Single-component, nonsag, neutral-curing, medium- to high-modulus silicone sealant; Class 25, Use NT (nontraffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone**].
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **BASF Building Systems**; Sonolastic NP.
    - b. **BASF Building Systems**; Sonolastic Ultra.
    - c. **Sika Corporation**; Sikaflex - 1a.
    - d. **Tremco Incorporated**; Vulkem 116.
    - e. **BASF Building Systems**; Omniseal 50.
    - f. **Dow Corning Corporation**; Spectrem 2.
    - g. **<Insert manufacturer's name; product name or designation>**.
    - h. or approved equal.
  2. VOC Content: **[250]** **<Insert value>** g/L.
  3. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.15 STONE ANCHORS AND ATTACHMENTS

- A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304.
1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** (ASTM F 738M) for bolts and **ASTM F 594** (ASTM F 836M) for nuts, Alloy Group **1** (A1).
- B. Fabricate dowels from stainless steel, ASTM A 276, Type 304.
- C. Fabricate anchors from extruded aluminum, **ASTM B 221** (ASTM B 221M), Alloy 6063-T6.
1. Fasteners for Extruded-Aluminum Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** (ASTM F 738M) for bolts and **ASTM F 594** (ASTM F 836M) for nuts, Alloy Group **1** (A1).
- D. Anchor Support Grids: Roll-formed steel channels, of size and shape required for application indicated, formed from galvanized-steel sheet not less than **0.108 inch** (2.8 mm) thick and complying with ASTM A 653/A 653M, **G90** (Z275).

1. Fittings and Fasteners: System manufacturer's standard components of design, size, and material required to securely attach grids to building structure and stone anchors to grids. Fabricate components in contact with stone from same material specified for anchors.
- E. Wire Tiebacks: **[No. 9 AWG copper or copper-alloy] [or] [0.120-inch- (3.0-mm-) diameter, stainless-steel]** wire.
- F. Dovetail Slots: Furnish dovetail slots with filler strips of slot size required to receive anchors provided, fabricated from **0.034-inch- (0.86-mm-)** thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)**.
- G. Direct-Mount Anchoring Systems: Stainless-steel[ **or aluminum**] stone anchors designed to be applied directly to wall surfaces[ **or to metal grids**]. System is secured to wall framing, furring, or sheet-metal reinforcing strips built into wall with[ **stainless-steel**] self-drilling screws. Anchors fit into kerfs or holes in edges of stone panels[ **and do not need setting spots**].
  1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. [Halfen Anchoring Systems; Meadow Burke.](#)
    - b. [Heckmann Building Products Inc.](#)
    - c. [Hohmann & Barnard, Inc.](#)
    - d. **<Insert manufacturer's name>**.
    - e. or approved equal.

## 2.16 STONE ACCESSORIES

- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
- B. Setting Shims for Direct-Mount Anchoring Systems: Strips of resilient plastic or neoprene, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- D. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Bostik, Inc.](#)
    - b. [Custom Building Products.](#)
    - c. [Hillyard, Inc.](#)

- d. [HMK Stone Care; ACI International.](#)
- e. [Miracle Sealants Company.](#)
- f. [Stone Care International.](#)
- g. [Summitville Tiles, Inc.](#)
- h. **<Insert manufacturer's name>.**
- i. or approved equal.

## 2.17 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
  1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone paneling in sizes and shapes required to comply with requirements indicated.
  1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
  2. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
  3. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
  1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
  2. Clean sawed backs of stones to remove rust stains and iron particles.
  3. Dress joints straight and at right angle to face unless otherwise indicated.
  4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
  5. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
- D. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
  1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match



range of colors and other appearance characteristics represented in approved Samples[ **and mockups**].

## 2.18 STONE WALL PANELING

- A. Arrange panels in shop or other suitable space in proposed orientation and sequence for examination by DEN Project Manager. Mark units with temporary sequence numbers to indicate position in proposed layout.
1. Lay out one elevation at a time if approved by DEN Project Manager.
  2. Notify DEN Project Manager seven (7) days in advance of date and time when layout will be available for viewing.
  3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by DEN Project Manager.
  4. Rearrange panels as directed by DEN Project Manager until layout is approved.
  5. Do not trim nonmodular-size units to less than modular size until after DEN Project Manager's approval of layout, unless otherwise approved by DEN Project Manager.
  6. Mark backs of units and Shop Drawings with sequence numbers based on approved layout. Mark backs of units to indicate orientation of units in completed Work.
- B. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [2 inches (50 mm)] unless otherwise indicated.
- C. Control depth of stone to maintain minimum clearances of [3/4 inch (20 mm)] [1 inch (25 mm)] between backs of panels and structural members, fireproofing if any, backup walls, and other work behind stone. Do not back check stone less than 1 inch (25 mm) thick.
- D. Cut stone to produce uniform joints [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [1/4 inch (6 mm)] [3/8 inch (10 mm)] <Insert dimension> wide and in locations indicated.
- E. Quirk-miter corners unless otherwise indicated. Fabricate for anchorage in top and bottom bed joints of corner units.
- F. Carve and cut [**inscriptions**] [**and**] [**decorative surfaces**]. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.
- G. Abrasively etch [**inscriptions**] [**and**] [**decorative surfaces**].
- H. Laser etch [**inscriptions**] [**and**] [**decorative surfaces**].
- I. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
1. Arrange panels with veining horizontal.
  2. Arrange panels with veining vertical.
  3. Arrange panels with veining as indicated on Drawings.
  4. Arrange panels in blend pattern.

5. Book match units, single-course height.
6. Book match units, both vertically and horizontally.
7. Book match units in each course. No matching is required between successive courses.
8. Slip match units, single-course height.
9. Slip match units, both vertically and horizontally.
10. Slip match units in each course. No matching is required between successive courses.

## 2.19 STONE COLUMN FACING

- A. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [2 inches (50 mm)] unless otherwise indicated.
- B. Joints: [1/16-inch- (1.5-mm-) **wide grouted**] [1/8-inch- (3-mm-) **wide grouted**] [1/8-inch- (3-mm-) **wide, sealant-filled**] [1/4-inch- (6-mm-) **wide, mortar-pointed**] [1/4-inch- (6-mm-) **wide, sealant-filled**] [3/8-inch- (10-mm-) **wide, mortar-pointed**] [3/8-inch- (10-mm-) **wide, sealant-filled**] <Insert dimension and description> joints.
- C. Quirk-miter corners unless otherwise indicated. Install anchorage in top and bottom bed joints of corner units.
- D. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
  1. Arrange panels with veining horizontal.
  2. Arrange panels with veining vertical.
  3. Arrange panels with veining as indicated on Drawings.

## 2.20 MIXES

- A. Spotting Plaster: Stiff mix of molding plaster and water.
- B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
  1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
  2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
- C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.
  1. Type: [N] [O].

2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:
1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
  2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
  3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
  4. Type: **[N]** **[O]**.
  5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 SETTING STONE, GENERAL**

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

- D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
  - 1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
  - 2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

### 3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/8 inch in 96 inches** (3 mm in 2400 mm), **1/4 inch** (6 mm) maximum.
- B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/8 inch** (3 mm).
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

### 3.4 INSTALLATION OF STONE PANELING

- A. Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart across back of unit, but provide no fewer than one setting spot per **2 sq. ft.** (0.18 sq. m) unless otherwise indicated.
  - 1. **Moisture Exposure:** Use Portland cement mortar for setting spots where stone is applied to inside face of exterior walls and **[where indicated] <Insert wet locations>**.

- B. Set units on direct-mount anchoring system with anchors securely attached to stone and to backup surfaces. Comply with anchoring recommendations in ASTM C 1242.
  - 1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant for filling kerfs.
  - 2. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.
- C. Minimum Anchors: Provide anchors at a maximum of **24 inches** (600 mm) o.c. around perimeter of stone panels with a minimum of four anchors per panel.
- D. Minimum Anchors: Provide a minimum of four anchors per panel up to **12 sq. ft.** (1.1 sq. m) in face area, plus a minimum of two additional anchors for each additional **8 sq. ft.** (0.7 sq. m).
- E. **[Grout] [Point]** joints after setting stone.
- F. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

### 3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
  - 1. Use sanded grout mixture for joints wider than **1/8 inch** (3 mm).
  - 2. Use unsanded grout mixture for joints **1/8 inch** (3 mm) and narrower.
- B. Remove temporary shims before grouting.
- C. Tool joints uniformly and smoothly with plastic tool.

### 3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch** (13 mm).
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch** (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch** (3 mm) larger than width of joint.

### 3.7 JOINT-SEALANT INSTALLATION

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

### 3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone paneling as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone paneling of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
  - 2. Defective stone paneling.
  - 3. Defective joints, including misaligned joints.
  - 4. Stone paneling and joints not matching approved Samples and mockups.
  - 5. Stone paneling not complying with other requirements indicated.
- C. Replace in a manner that results in stone paneling that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.
- D. Clean stone paneling no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

### 3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 097513

## SECTION 097516 - STONE BASE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes stone base.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for sealing expansion joints in stone base.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each[ **variety of stone,**] stone accessory, and manufactured product.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
    - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and



fraction by weight of each regionally manufactured material that is regionally extracted.

3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
  4. Laboratory Test Reports for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for stone base, including dimensions and profiles of stone units.
1. Show locations and details of joints.
  2. Show locations and details of anchors, including locations of supporting construction.
- D. Samples for Initial Selection: For joint materials involving color selection.
- E. Samples for Verification:
1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include **[two] [three] [four] [five] <Insert number>** or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
  2. For each color of **[grout] [pointing mortar] [and] [sealant]** required.

#### 1.4 INFORMATIONAL SUBMITTALS

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

#### 1.5 CLOSEOUT SUBMITTALS

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

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone base.
- C. Installer Qualifications: A firm or individual experienced in installing stone base similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockup for stone base, not less than **72 inches** (1800 mm) long.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

## 1.9 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than **50 deg F** (10 deg C) during installation and for seven days after completion.

- B. Field Measurements: Verify dimensions of construction to receive stone base by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.10 COORDINATION

- A. Time delivery and installation of stone base to avoid extended on-site storage and to coordinate with work adjacent to stone base.

#### 1.11 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain **[each variety of]** stone, **[regardless of finish, ]**from a single quarry**[, whether specified in this Section or in another Section of the Specifications,]** with resources to provide materials of consistent quality in appearance and physical properties.
  - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

#### 2.2 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.
- B. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: Uniform, **[fine] [medium]-grained, [white] [pink] [gray] [black] <Insert color>** stone**[ without veining]**.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.

2. or approved equal.

F. Cut: [**Vein**] [**Fleuri**].

1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].

G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

H. Finish: [**Polished**] [**Honed**] [**Thermal**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.

I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

### 2.3 LIMESTONE <Insert drawing designation>

A. Material Standard: Comply with ASTM C 568.

1. Classification: [**I Low**] [**II Medium**] [**III High**] Density.

B. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.

C. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site.

D. Description: [**Dolomitic**] [**Oolitic**] [**Shell**] limestone.

E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.

2. or approved equal.

F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.

1. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.

G. Cut: [**Vein**] [**Fleuri**].

1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].

H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

- I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish> [, **matching standard ILI finish**].
- J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

#### 2.4 MARBLE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 503[, **Classification I Calcite**] [, **Classification II Dolomite**] [, **Group A**] [, **Group B**] [, **Group C**] [, **Group D**].
- B. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: Uniform, fine- to medium-grained, [**white**] <Insert color> stone with only slight veining.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- F. Cut: [**Vein**] [**Fleuri**].
  - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

#### 2.5 QUARTZ-BASED STONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 616, [**Classification I Sandstone**] [**Classification II Quartzitic Sandstone**] [**Classification III Quartzite**] [, **except for minimum free silica content**].

- B. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
  - 2. or approved equal.
- E. Finish: [**Sand rubbed**] [**Natural cleft**] [**Thermal**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
  - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

- 2.7 SLATE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 629, [**Classification I Exterior**] [**Classification II Interior**].
  - B. Regional Materials: Slate shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
  - C. Regional Materials: Slate shall be fabricated within **500 miles** (800 km) of Project site.
  - D. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[ **and unfading color,**] from clear, sound stock.
  - E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
    - 2. or approved equal.
  - F. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
  - G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.8 TRAVERTINE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].
  - B. Regional Materials: Travertine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
  - C. Regional Materials: Travertine shall be fabricated within **500 miles** (800 km) of Project site.
  - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
    - 2. or approved equal.
  - E. Cut: [**Vein**] [**Fleuri**].
    - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].

- F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

## 2.9 OTHER STONE <Insert drawing designation>

- A. Material Standards:
  - 1. Maximum Absorption per ASTM C 97/C 97M: <Insert required value>.
  - 2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert required value>.
  - 3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert required value>.
- B. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

## 2.10 SETTING MATERIALS

- A. Molding Plaster: ASTM C 59/C 59M.
- B. Portland Cement: ASTM C 150, Type I or Type II.
  - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.



- D. Aggregate: ASTM C 144.
- E. Water: Potable.
- F. Adhesives, General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- G. Organic Adhesive: ANSI A136.1, Type I[.], with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Boiardi Products; a QEP company.](#)
    - b. [Bostik, Inc.](#)
    - c. [C-Cure.](#)
    - d. [Custom Building Products.](#)
    - e. [DAP Inc.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)
    - i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
    - j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
    - k. [Southern Grouts & Mortars, Inc.](#)
    - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
    - m. <Insert manufacturer's name>.
    - n. or approved equal.
- H. Water-Cleanable Epoxy Adhesive: ANSI A118.3[.], with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Boiardi Products; a QEP company.](#)
    - b. [Bonstone Materials Corporation.](#)
    - c. [Bostik, Inc.](#)
    - d. [C-Cure.](#)
    - e. [Custom Building Products.](#)
    - f. [Jamo Inc.](#)
    - g. [Laticrete International, Inc.](#)
    - h. [MAPEI Corporation.](#)
    - i. [Mer-Krete Systems; ParexLahabra, Inc.](#)

- j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
  - k. [Summitville Tiles, Inc.](#)
  - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
  - m. <Insert manufacturer's name>.
  - n. or approved equal.
- I. Stone Adhesive: Two-part, [epoxy-resin] [or] [polyester-resin] stone adhesive with an initial set time of not more than two hours at 70 deg F (21 deg C)[.], **and with a VOC content of 65 g/L or less.**[, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
- 1. Color: [Clear] [Match stone].
  - 2. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Epoxy Adhesive: [Akemi North America](#); Akepox.
    - b. Epoxy Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Akabond Epoxy.
    - c. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Last Patch.
    - d. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Ratio Pac Clear Gel Epoxy.
    - e. Epoxy Adhesive: <Insert manufacturer's name; product name or designation>.
    - f. Polyester Adhesive: [Akemi North America](#); Platinum Clear Polyester Adhesive.
    - g. Polyester Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Wood & Stone Polyester.
    - h. Polyester Adhesive: [Bonstone Materials Corporation](#); Gripstone L-200KG.
    - i. Polyester Adhesive: <Insert manufacturer's name; product name or designation>.
    - j. or approved equal.

## 2.11 GROUT

- A. Grout Colors: [Match stone] [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
  - 1. Grout Type: [Sanded] [Unsanded].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Bostik, Inc.
    - b. C-Cure.
    - c. Custom Building Products.
    - d. DAP Inc.
    - e. Jamo Inc.
    - f. Laticrete International, Inc.
    - g. MAPEI Corporation.
    - h. Mer-Krete Systems; ParexLahabra, Inc.
    - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
    - j. Southern Grouts & Mortars, Inc.
    - k. Summitville Tiles, Inc.
    - l. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
    - m. **<Insert manufacturer's name>**.
    - n. or approved equal.
  2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
  3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
  4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. Jamo Inc.
    - f. Laticrete International, Inc.
    - g. MAPEI Corporation.
    - h. Mer-Krete Systems; ParexLahabra, Inc.
    - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
    - j. Summitville Tiles, Inc.
    - k. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
    - l. **<Insert manufacturer's name>**.
    - m. or approved equal.

## 2.12 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **Davis Colors**; True Tone Mortar Colors.
    - b. **Lanxess Corporation**; Bayferrox Iron Oxide Pigments.
    - c. **Solomon Colors**; SGS Mortar Colors.
    - d. **<Insert manufacturer's name; product name or designation>**.
    - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **Holcim (US) Inc.**; Rainbow Mortamix Custom Color Cement/Lime.
    - b. **Lafarge North America Inc.**; Eaglebond.
    - c. **Lehigh Cement Company**; Lehigh Custom Color Portland/Lime Cement.
    - d. **<Insert manufacturer's name; product name or designation>**.
    - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16 (1.18-mm)** sieve.
1. White Aggregates: Natural white sand or ground white stone.
  2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

## 2.13 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

1. Mildew-Resistant Joint Sealant: [**Mildew resistant, single component, nonsag, neutral curing, silicone**] [**Single component, nonsag, mildew resistant, acid curing, silicone**] <Insert joint sealant>.
2. Joint Sealant: [**Latex**] [**Acrylic based**] [**Butyl rubber based**] [**Single component, nonsag, neutral curing, silicone; Class 25**] <Insert joint sealant>.
3. VOC Content: [**250**] <Insert value> g/L or less.
4. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.

## 2.14 STONE ANCHORS AND ATTACHMENTS

- A. Wire Tiebacks: [**No. 9 AWG copper or copper-alloy**] [or] [**0.120-inch- (3.0-mm-) diameter, stainless-steel**] wire.

## 2.15 STONE ACCESSORIES

- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
- B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Bostik, Inc.](#)
    - b. [Custom Building Products.](#)
    - c. [Hillyard, Inc.](#)
    - d. [HMK Stone Care; ACI International.](#)
    - e. [Miracle Sealants Company.](#)
    - f. [Stone Care International.](#)
    - g. [Summitville Tiles, Inc.](#)
    - h. <Insert manufacturer's name>.
    - i. or approved equal.

## 2.16 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
- Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone base in sizes and shapes required to comply with requirements indicated.
- For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
  - For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
  - For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
- Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
  - Clean sawed backs of stones to remove rust stains and iron particles.
  - Dress joints straight and at right angle to face unless otherwise indicated.
- D. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units.
- Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
- Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples[ **and mockups**].

## 2.17 STONE BASE

- A. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1-1/4 inches (32 mm)] unless otherwise indicated.

- B. Top-Edge Detail: [**Straight, slightly eased at corner**] [**3/8-inch (10-mm) bevel**] [**3/4-inch (20-mm) radius**] [**3/8-inch (10-mm) radius**] [**As indicated**].
- C. Ends: [**Butt ends into casings**] [**Butt ends into opening frames**] [**Return ends to depth of adjacent finish with edge detail same as top edge**] unless otherwise indicated.
- D. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].
  - 1. Locate joints at midpoints between adjacent paneling joints unless otherwise indicated.

## 2.18 MIXES

- A. Spotting Plaster: Stiff mix of molding plaster and water.
- B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
  - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
  - 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
- C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.
  - 1. Type: [**N**] [**O**].
  - 2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:
  - 1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
  - 2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
  - 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
  - 4. Type: [**N**] [**O**].

5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 SETTING STONE, GENERAL**

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- D. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- E. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
  1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
  2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.



### 3.3 CONSTRUCTION TOLERANCES

- A. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- B. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- C. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

### 3.4 INSTALLATION OF STONE BASE

- A. Stone Base: At locations with stone paneling, set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- B. Stone Base: At locations with stone paneling, set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone base up to **48 inches** (1200 mm) in length, plus one additional anchor for each additional **24 inches** (600 mm) of length.
- C. Stone Base: At locations without stone paneling, adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- D. Stone Base: At locations without stone paneling, adhere units to gypsum board with full spread of **[organic] [water-cleanable epoxy]** adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- E. Assemble indicated multiple-piece stone base by bonding joints with stone adhesive as units are set. Mask areas adjacent to joints to prevent adhesive smears. Clamp units in place to ensure that surfaces are properly aligned and joints are minimum width.
- F. **[Grout] [Point]** joints after setting stone.
- G. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

### 3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
  - 1. Use sanded grout mixture for joints wider than **1/8 inch** (3 mm).
  - 2. Use unsanded grout mixture for joints **1/8 inch** (3 mm) and narrower.
- B. Remove temporary shims before grouting.

- C. Tool joints uniformly and smoothly with plastic tool.

### 3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch (13 mm)**.
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint.

### 3.7 JOINT-SEALANT INSTALLATION

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

### 3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone base as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone base of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
  - 2. Defective stone base.
  - 3. Defective joints, including misaligned joints.
  - 4. Stone base and joints not matching approved Samples and mockups.
  - 5. Stone base not complying with other requirements indicated.
- C. Replace in a manner that results in stone base that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.
- D. Clean stone base no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

### 3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 097516

## SECTION 097519 - STONE TRIM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes interior stone trim.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for sealing expansion joints in interior stone trim.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each[ **variety of stone,**] stone accessory, and manufactured product.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[ **and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.

- a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
  3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
  4. Laboratory Test Reports for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - C. Shop Drawings: Show fabrication and installation details for stone trim, including dimensions and profiles of stone units.
    1. Show locations and details of joints.
    2. Show locations and details of anchors, including locations of supporting construction.
  - D. Samples for Initial Selection: For joint materials involving color selection.
  - E. Samples for Verification:
    1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include **[two] [three] [four] [five]** **<Insert number>** or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
    2. For each color of **[grout] [pointing mortar] [and] [sealant]** required.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For **[Installer] [fabricator]**.
  - B. Material Test Reports:
    1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **[three] [five]** **<Insert number>** years.
    2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of interior stone trim.
- C. Installer Qualifications: A firm or individual experienced in installing interior stone trim similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockups for typical interior stone trim as shown on Drawings.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical units so that they are right side up when units are installed.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

#### 1.10 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for seven days after completion.
- B. Field Measurements: Verify dimensions of construction to receive interior stone trim by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.11 COORDINATION

- A. Time delivery and installation of interior stone trim to avoid extended on-site storage and to coordinate with work adjacent to interior stone trim.

#### 1.12 CONSTRUCTION WASTE MANAGEMENT

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[ **each variety of**] stone, [**regardless of finish,**] from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
  - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

#### 2.2 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.
- B. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.

- C. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: Uniform, [fine] [medium]-grained, [white] [pink] [gray] [black] <Insert color> stone[ without veining].
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- F. Cut: [Vein] [Fleuri].
  - 1. Orientation of Veining: [Horizontal] [Vertical] [As indicated].
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: [Polished] [Honed] [Thermal] [As indicated] [Match DEN Project Manager's sample] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

### 2.3 LIMESTONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 568.
  - 1. Classification: [I Low] [II Medium] [III High] Density.
- B. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: [Dolomitic] [Oolitic] [Shell] limestone.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.



1. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.
  - G. Cut: [**Vein**] [**Fleuri**].
    1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
  - H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
  - I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish> [, **matching standard ILI finish**].
  - J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.4 MARBLE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 503[, **Classification I Calcite**] [, **Classification II Dolomite**] [, **Group A**] [, **Group B**] [, **Group C**] [, **Group D**].
  - B. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
  - C. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site.
  - D. Description: Uniform, fine- to medium-grained, [**white**] <Insert color> stone with only slight veining.
  - E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
    2. or approved equal.
  - F. Cut: [**Vein**] [**Fleuri**].
    1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
  - G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
  - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.

- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

## 2.5 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

## 2.6 TRAVERTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Travertine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Travertine shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
  - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
  - 2. or approved equal.
- E. Cut: [**Vein**] [**Fleuri**].

1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
  - F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
  - G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
  - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
  - I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.7 OTHER STONE <Insert drawing designation>
- A. Material Standards:
    1. Maximum Absorption per ASTM C 97/C 97M: <Insert required value>.
    2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert required value>.
    3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert required value>.
  - B. Regional Materials: Stone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
  - C. Regional Materials: Stone shall be fabricated within 500 miles (800 km) of Project site.
  - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
    1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
    2. or approved equal.
  - E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
  - F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.8 SETTING MATERIALS
- A. Molding Plaster: ASTM C 59/C 59M.
  - B. Portland Cement: ASTM C 150, Type I or Type II.
    1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.

- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate: ASTM C 144.
- E. Water: Potable.
- F. Adhesives, General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- G. Organic Adhesive: ANSI A136.1, Type I[.], **with a VOC content of 65 g/L.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**

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

- a. [Boiardi Products; a QEP company.](#)
- b. [Bostik, Inc.](#)
- c. [C-Cure.](#)
- d. [Custom Building Products.](#)
- e. [DAP Inc.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
- j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
- k. [Southern Grouts & Mortars, Inc.](#)
- l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
- m. **<Insert manufacturer's name>**.
- n. or approved equal.

- H. Water-Cleanable Epoxy Adhesive: ANSI A118.3[.], **with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**

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

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonstone Materials Corporation.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)

- i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
  - j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
  - k. [Summitville Tiles, Inc.](#)
  - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
  - m. <Insert manufacturer's name>.
  - n. or approved equal.
- I. Stone Adhesive: Two-part, [**epoxy-resin**] [or] [**polyester-resin**] stone adhesive with an initial set time of not more than two hours at 70 deg F (21 deg C)[.], **and with a VOC content of 65 g/L or less.**], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. Color: [**Clear**] [**Match stone**].
  2. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Epoxy Adhesive: [Akemi North America](#); Akepox.
    - b. Epoxy Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Akabond Epoxy.
    - c. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Last Patch.
    - d. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Ratio Pac Clear Gel Epoxy.
    - e. Epoxy Adhesive: <Insert manufacturer's name; product name or designation>.
    - f. Polyester Adhesive: [Akemi North America](#); Platinum Clear Polyester Adhesive.
    - g. Polyester Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Wood & Stone Polyester.
    - h. Polyester Adhesive: [Bonstone Materials Corporation](#); Gripstone L-200KG.
    - i. Polyester Adhesive: <Insert manufacturer's name; product name or designation>.
    - j. or approved equal.

## 2.9 GROUT

- A. Grout Colors: [**Match stone**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
  1. Grout Type: [**Sanded**] [**Unsanded**].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Bostik, Inc.
    - b. C-Cure.
    - c. Custom Building Products.
    - d. DAP Inc.
    - e. Jamo Inc.
    - f. Laticrete International, Inc.
    - g. MAPEI Corporation.
    - h. Mer-Krete Systems; ParexLahabra, Inc.
    - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
    - j. Southern Grouts & Mortars, Inc.
    - k. Summitville Tiles, Inc.
    - l. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
    - m. **<Insert manufacturer's name>**.
    - n. or approved equal.
  2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
  3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
  4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. Jamo Inc.
    - f. Laticrete International, Inc.
    - g. MAPEI Corporation.
    - h. Mer-Krete Systems; ParexLahabra, Inc.
    - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
    - j. Summitville Tiles, Inc.
    - k. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
    - l. **<Insert manufacturer's name>**.
    - m. or approved equal.

## 2.10 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **Davis Colors;** True Tone Mortar Colors.
    - b. **Lanxess Corporation;** Bayferrox Iron Oxide Pigments.
    - c. **Solomon Colors;** SGS Mortar Colors.
    - d. **<Insert manufacturer's name; product name or designation>.**
    - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **Holcim (US) Inc.;** Rainbow Mortamix Custom Color Cement/Lime.
    - b. **Lafarge North America Inc.;** Eaglebond.
    - c. **Lehigh Cement Company;** Lehigh Custom Color Portland/Lime Cement.
    - d. **<Insert manufacturer's name; product name or designation>.**
    - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16 (1.18-mm)** sieve.
1. White Aggregates: Natural white sand or ground white stone.
  2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

## 2.11 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

1. Mildew-Resistant Joint Sealant: **[Mildew resistant, single component, nonsag, neutral curing, silicone] [Single component, nonsag, mildew resistant, acid curing, silicone] <Insert joint sealant>**.
  2. Joint Sealant: **[Latex] [Acrylic based] [Butyl rubber based] [Single component, nonsag, neutral curing, silicone; Class 25] <Insert joint sealant>**.
  3. VOC Content: **[250] <Insert value>** g/L or less.
  4. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  5. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.
- B. Sealant for Filling Kerfs: **[Same sealant used for joints in dimension stone] [Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone] [Single-component, nonsag, neutral-curing, medium- to high-modulus silicone sealant; Class 25, Use NT (nontraffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone]**.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. **BASF Building Systems**; Sonolastic NP 1.
    - b. **BASF Building Systems**; Sonolastic Ultra.
    - c. **Sika Corporation**; Sikaflex - 1a.
    - d. **Tremco Incorporated**; Vulkem 116.
    - e. **BASF Building Systems**; Omniseal 50.
    - f. Dow Corning Corporation; 756 SMS.
    - g. **General Electric Company**; GE Advanced Materials - Silicones; SilPruf NB SCS9000.
    - h. **Tremco Incorporated**; Spectrem 2.
    - i. **<Insert manufacturer's name; product name or designation>**.
    - j. or approved equal.
  2. VOC Content: **[250] <Insert value>** g/L or less.
  3. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.12 STONE ANCHORS AND ATTACHMENTS
- A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304.



1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy Group 1 (A1).
  - B. Fabricate dowels from stainless steel, ASTM A 276, Type 304.
  - C. Fabricate anchors from extruded aluminum, [ASTM B 221](#) (ASTM B 221M), Alloy 6063-T6.
    1. Fasteners for Extruded-Aluminum Anchors: Annealed stainless-steel bolts, nuts, and washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy Group 1 (A1).
  - D. Wire Tiebacks: [**No. 9 AWG copper or copper-alloy**] [or] [**0.120-inch- (3.0-mm-) diameter, stainless-steel**] wire.
- 2.13 STONE ACCESSORIES
- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
  - B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
  - C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
    1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      - a. [Bostik, Inc.](#)
      - b. [Custom Building Products.](#)
      - c. [Hillyard, Inc.](#)
      - d. [HMK Stone Care; ACI International.](#)
      - e. [Miracle Sealants Company.](#)
      - f. [Stone Care International.](#)
      - g. [Summitville Tiles, Inc.](#)
      - h. **<Insert manufacturer's name>.**
      - i. or approved equal.

2.14 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone trim in sizes and shapes required to comply with requirements indicated.
1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
  2. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
  3. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
  2. Clean sawed backs of stones to remove rust stains and iron particles.
  3. Dress joints straight and at right angle to face unless otherwise indicated.
  4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
- D. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units.
1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
  2. Miter moldings at corners, unless otherwise indicated, with edges of miters slightly eased at outside corners.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples[ **and mockups**].

## 2.15 STONE TRIM

- A. Flat Trim:

1. Nominal Thickness: [**3/4 inch (20 mm)**] [**7/8 inch (22 mm)**] [**1-1/4 inches (32 mm)**] [**1-1/2 inches (40 mm)**] unless otherwise indicated.
2. Edge Detail: [**Straight, slightly eased at corners**] [**3/8-inch (10-mm) bevels**] [**3/4-inch (20-mm) radii**] [**3/8-inch (10-mm) radii**] [**As indicated**].
3. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].

B. Molded Trim:

1. Profile: Match [**profiles indicated on Drawings**] [**existing**].
2. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].

2.16 MIXES

A. Spotting Plaster: Stiff mix of molding plaster and water.

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

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

C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.

1. Type: [**N**] [**O**].
2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.

D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
4. Type: [**N**] [**O**].

5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 SETTING STONE, GENERAL**

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.
- D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
  1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
  2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

### 3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/8 inch in 96 inches** (3 mm in 2400 mm), **1/4 inch** (6 mm) maximum.
- B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/8 inch** (3 mm).
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

### 3.4 INSTALLATION

- A. Stone Trim: At locations with stone paneling, set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- B. Stone Trim: At locations with stone paneling, set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone trim up to **48 inches** (1200 mm) in length, plus one additional anchor for each additional **24 inches** (600 mm) of length.
- C. Stone Trim: At locations without stone paneling, adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- D. Stone Trim: At locations without stone paneling, adhere units to gypsum board with full spread of **[organic] [water-cleanable epoxy]** adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- E. Assemble indicated multiple-piece stone trim by bonding joints with stone adhesive as units are set. Mask areas adjacent to joints to prevent adhesive smears. Clamp units in place to ensure that surfaces are properly aligned and joints are minimum width.
- F. **[Grout] [Point]** joints after setting stone.
- G. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

### 3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
  - 1. Use sanded grout mixture for joints wider than **1/8 inch (3 mm)**.
  - 2. Use unsanded grout mixture for joints **1/8 inch (3 mm)** and narrower.
- B. Remove temporary shims before grouting.
- C. Tool joints uniformly and smoothly with plastic tool.

### 3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch (13 mm)**.
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint.

### 3.7 JOINT-SEALANT INSTALLATION

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

### 3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean interior stone trim as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace interior stone trim of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
  - 2. Defective stone trim.
  - 3. Defective joints, including misaligned joints.
  - 4. Interior stone trim and joints not matching approved Samples and mockups.
  - 5. Interior stone trim not complying with other requirements indicated.
- C. Replace in a manner that results in interior stone trim that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

- D. Clean interior stone trim no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

### 3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 097519

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on **[interior substrates.] [the following interior substrates:]**

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Steel.
5. Cast iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Gypsum board.
10. Plaster.
11. Spray-textured ceilings.
12. Cotton or canvas insulation covering.
13. ASJ insulation covering.

- B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
2. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings.
3. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
5. Section 099419 "Multicolor Interior Finishing" for speckled finishes on interior surfaces.

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



### 1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
    - a. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
    - b. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
  - 2. Laboratory Test Reports for Credit EQ 4: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - 3. Interior Paints: Manufacturer's product data and material safety data sheets (MSDS) for paints and coatings used on the interior of the building including printed statement of VOC content in g/L.
- C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, **8 inches** (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.
5. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
6. Resubmit until required sheen, color, and texture are achieved.
7. Submit **<Insert number>** samples on the following substrates for DEN Project Manager's review of color and texture only:
  - a. Concrete: **[4-inch- square] [4-by-6-inch] <Insert size and shape>** Samples for each color and finish.
  - b. Concrete Unit Masonry: **[4-by-8-inch] [6-by-10-inch] <Insert size>** Samples of masonry, with mortar joint in the center, for each finish and color.
  - c. Painted Wood: **[8-inch-] [12-inch-] <Insert size>** square Samples for each color and material on hardboard.
  - d. Ferrous Metal: **[3-inch-] [4-inch-] <Insert size>** square Samples of flat metal and **[6-inch-] [8-inch-] <Insert size>** long Samples of solid metal for each color and finish.

E. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: **[5] <Insert number>** percent, but not less than **[1 gal. (3.8 L)] <Insert number>** of each material and color applied.

## 1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. DEN Project Manager will select one surface to represent surfaces and

conditions for application of each paint system specified in Part 3.

- a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
  - b. Other Items: DEN Project Manager will designate items or areas required.
2. Final approval of color selections will be based on mockups.
- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by DEN Project Manager at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Manufacturer's stock number and date of manufacture.
  4. Contents by volume, for pigment and vehicle constituents.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
  8. VOC content.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F (10 and 33 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

## 1.9 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner, and store in location as determined by DEN Project Manager.
1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
    - a. Interior, Flat Acrylic Paint: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
    - b. Interior, Low-Luster Acrylic Finish: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
    - c. Interior, Semigloss Acrylic Enamel: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
    - d. Interior, Full-Gloss Alkyd Enamel: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color required.
    - e. <Insert other type and quantity>.
  2. Quantity: Furnish Owner with an additional [3] [5] [7] <Insert percent> percent, but not less than [1] <Insert number> gal., as appropriate, of each material and color applied.

## 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Benjamin Moore & Co.
  2. ICI Dulux Paints.
  3. Kelly-Moore Paints.
  4. M.A.B. Paints.
  5. PPG Architectural Finishes, Inc.
  6. Sherwin-Williams Company (The).
  7. Sico, Inc.
  8. <Insert manufacturer's name>.
  9. or approved equal.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated, or equal approved by DEN

Project Manager.

## 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[ **and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].
1. Flat Paints and Coatings: 50 g/L.
  2. Nonflat Paints and Coatings: 150 g/L.
  3. Dry-Fog Coatings: 400 g/L.
  4. Primers, Sealers, and Undercoaters: 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  7. Pretreatment Wash Primers: 420 g/L.
  8. Floor Coatings: 100 g/L.
  9. Shellacs, Clear: 730 g/L.
  10. Shellacs, Pigmented: 550 g/L.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirements>.
1. [**10**] [**20**] [**30**] <Insert number> percent of surface area will be painted with deep tones.

## 2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior:[ **MPI #4.**]
1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.

2. Benjamin Moore; Moore's IMC Latex Block Filler No. M88: Applied at a dry film thickness of not less than 8.1 mils.
3. ICI Dulux Paints; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils.
4. Kelly-Moore; 521 Fill and Prime Acrylic Block Filler: Applied at a dry film thickness of not less than 10.0 mils.
5. M. A. B. Paint; Block Kote No. 1000 Acrylic Latex Block Filler 064-145: Applied at a dry film thickness of not less than 12.0 mils.
6. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils.
7. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

## 2.4 PRIMERS/SEALERS

### A. Primer Sealer, Latex, Interior:[ **MPI #50.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 1000-1200 Dulux Ultra Basecoat Interior Latex Wall Primer: Applied at a dry film thickness of not less than 1.2 mils.
3. ICI Dulux Paints; 1030-1200 Ultra-Hide PVA Interior Primer Sealer General Purpose Wall Primer: Applied at a dry film thickness of not less than 1.9 mils.
4. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
5. M. A. B. Paint; Fresh Kote Vinyl Primer 037-100: Applied at a dry film thickness of not less than 1.5 mils.
6. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.
7. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

### B. Primer, Alkali Resistant, Water Based, for Concrete and Masonry:[ **MPI #3.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 3030-1200 Bond-Prep Interior/Exterior Waterborne Pigmented Bonding Primer: Applied at a dry film thickness of not less than 1.8 mils.
3. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
4. M. A. B. Paint; Fresh Kote Vinyl Primer 037-100: Applied at a dry film thickness of not less than 1.5 mils.
5. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a

- dry film thickness of not less than 1.0 mil.
6. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils.
  7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
  8. or approved equal.
- C. Primer Sealer, Interior, Institutional Low Odor/VOC:[ **MPI #149.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- D. Primer, Latex, for Interior Wood:[ **MPI #39.**]
1. Benjamin Moore; Moorcraft Super Spec Alkyd Enamel Underbody and Primer Sealer No. 245: Applied at a dry film thickness of not less than 1.5 mils.
  2. ICI Dulux Paints; 3210-1200 Ultra-Hide Aquacrylic GRIPPER Stain Killer Primer Sealer: Applied at a dry film thickness of not less than 1.8 mils.
  3. Kelly-Moore; 975 Acry Plex Interior Latex Enamel Undercoat: Applied at a dry film thickness of not less than 1.6 mils.
  4. M. A. B. Paint; Rich Lux Latex Undercoat 037-154: Applied at a dry film thickness of not less than 1.5 mils.
  5. Pittsburgh Paints; 6-855 SpeedHide Latex Enamel Undercoater: Applied at a dry film thickness of not less than 1.0 mil.
  6. Sherwin-Williams; PrepRite Wall and Wood Primer B49W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
  7. Sherwin-Williams; PrepRite Classic Interior Primer B28W101 Series: Applied at a dry film thickness of not less than 1.6 mils.
  8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
  9. or approved equal.
- E. Primer Sealer, Alkyd, Interior:[ **MPI #45.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- F. Primer, Bonding, Water Based:[ **MPI #17.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- G. Primer, Bonding, Solvent Based:[ **MPI #69.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- H. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

## 2.5 METAL PRIMERS

### A. Primer, Rust-Inhibitive, Water Based:[ **MPI #107.**]

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4130-6130 Devshield Rust Penetrating Metal Primer: Applied at a dry film thickness of not less than 2.2 mils.
3. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
4. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
5. M. A. B. Paint; Rust-O-Lastic Anti-Corrosive Primer 073-132: Applied at a dry film thickness of not less than 2.0 mils.
6. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 1.5 mils.
7. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

### B. Primer, Alkyd, Anti-Corrosive, for Metal:[ **MPI #79.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

### C. Primer, Alkyd, Quick Dry, for Metal:[ **MPI #76.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

### D. Primer, Galvanized, Water Based:[ **MPI #134.**]

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
3. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
4. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils.
5. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
6. Sherwin-Williams; primer not required over this substrate.
7. Sherwin-Williams; Galvite HS B50WZ30: Applied at a dry film thickness of not



- less than 3.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  9. or approved equal.

E. Primer, Vinyl Wash:[ **MPI #80.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

F. Primer, Quick Dry, for Aluminum:[ **MPI #95.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

## 2.6 WATER-BASED PAINTS

A. Latex, Interior, Flat, (Gloss Level 1):[ **MPI #53.**]

1. Benjamin Moore; Moorecraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 1200-XXXX Dulux Professional Velvet Matte Interior Flat Latex Wall & Trim Finish: Applied at a dry film thickness of not less than 1.4 mils.
3. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint: Applied at a dry film thick-ness of not less than 1.8 mils.
4. M. A. B. Paint; Fresh Kote Latex Flat 402 Line: Applied at a dry film thickness of not less than 1.5 mils.
5. Pittsburgh Paints; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint: Applied at a dry film thickness of not less than 1.0 mil.
6. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
8. or approved equal.

B. Latex, Interior, Eggshell, (Gloss Level 2):[ **MPI #44.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
2. ICI Dulux Paints; 1402-XXXX Dulux Professional Acrylic Eggshell Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.4 mils.
3. Kelly-Moore; 1610 Sat-N-Sheen Interior Latex Low Sheen Wall and Trim Finish: Ap-plied at a dry film thickness of not less than 1.6 mils.
4. Kelly-Moore; 1686 Dura-Poxy Eggshell Acrylic Enamel: Applied at a dry film thick-ness of not less than 1.6 mils.
5. M. A. B. Paint; Fresh Kote Latex Satin Eggshell Enamel 405 Line: Applied at a dry film thickness of not less than 1.5 mils.
6. Pittsburgh Paints; 6-400 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils.

7. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
  8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  9. or approved equal.
- C. Latex, Interior, (Gloss Level 3):[ **MPI #52.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- D. Latex, Interior, (Gloss Level 4):[ **MPI #43.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5):[ **MPI #54.**]
1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
  2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils.
  3. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
  4. Kelly-Moore; 1685 Dura-Poxy Semi-Gloss Acrylic Enamel: Applied at a dry film thick-ness of not less than 1.5 mils.
  5. M. A. B. Paint; Fresh Kote Latex Semi-Gloss 410 Line: Applied at a dry film thickness of not less than 1.5 mils.
  6. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil.
  7. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.
  8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  9. or approved equal.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees):[ **MPI #114.**]
1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel No. M28: Applied at a dry film thickness of not less than 2.0 mils.
  2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish: Applied at a dry film thickness of not less than 1.6 mils.
  3. Kelly-Moore; 1680 Dura-Poxy Gloss Acrylic Enamel: Applied at a dry film thickness of not less than 1.6 mils.
  4. M. A. B. Paint; Rich Lux Architectural High Gloss Latex Enamel 022-127 Line: Applied at a dry film thickness of not less than 1.5 mils.
  5. Pittsburgh Paints; 6-8534 SpeedHide Interior Latex 100 Percent Acrylic Gloss Enamels: Applied at a dry film thickness of not less than 1.0 mil.
  6. Pittsburgh Paints; 90-374 Pitt-Tech One Pack Interior/Exterior High Performance

- Waterborne High Gloss DTM Industrial Enamel (recommended for ferrous and zinc-coated metal): Applied at a dry film thickness of not less than 3.0 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  8. or approved equal.
- G. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1):[ **MPI #143.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- H. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2):[ **MPI #144.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- I. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3):[ **MPI #145.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- J. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5):[ **MPI #147.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- K. Latex, Interior, High Performance Architectural, (Gloss Level 2):[ **MPI #138.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- L. Latex, Interior, High Performance Architectural, (Gloss Level 3):[ **MPI #139.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- M. Latex, Interior, High Performance Architectural, (Gloss Level 4):[ **MPI #140.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- N. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5):[ **MPI #141.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- O. Light Industrial Coating, Interior, Water Based (Gloss Level 3):[ **MPI #151.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

P. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5):[ **MPI #153.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

Q. Light Industrial Coating, Interior, Water Based, Gloss (Gloss Level 6):[ **MPI #154.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

## 2.7 SOLVENT-BASED PAINTS

A. Alkyd, Interior, Flat (Gloss Level 1):[ **MPI #49.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Alkyd, Interior, (Gloss Level 3):[ **MPI #51.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Alkyd, Interior, Semi-Gloss (Gloss Level 5):[ **MPI #47.**]

1. Benjamin Moore; Moorcraft Super Spec Alkyd Semi-Gloss Enamel No. 271: Applied at a dry film thickness of not less than 1.4 mils.
2. ICI Dulux Paints; 1516-XXXX Ultra-Hide Alkyd Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.7 mils.
3. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.2 mils.
4. M. A. B. Paint; Fresh Kote Semi-Gloss 403 Line: Applied at a dry film thickness of not less than 2.0 mils.
5. Pittsburgh Paints; 6-1110 Series SpeedHide Interior Enamel Wall & Trim Semi-Gloss Oil: Applied at a dry film thickness of not less than 1.4 mils.
6. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
8. or approved equal.

D. Alkyd, Interior, Gloss (Gloss Level 6):[ **MPI #48.**]

1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel No. M22: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils.
3. Kelly-Moore; 1700 Kel-Guard Gloss Alkyd Rust Inhibitive Enamel: Applied at a dry film thickness of not less than 2.0 mils.
4. M. A. B. Paint; Rich Lux Architectural Bright White Enamel 026-127 Line: Applied

- at a dry film thickness of not less than 1.9 mils.
5. Pittsburgh Paints; 7-814 Series Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less than 1.5 mils.
  6. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
  7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  8. or approved equal.

E. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5):[ **MPI #81.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

F. Alkyd, Quick Dry, Gloss (Gloss Level 7):[ **MPI #96.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

## 2.8 TEXTURED COATING

A. Primer for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Intermediate Coat for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Textured Coating, Latex, Flat:[ **MPI #42.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

## 2.9 DRY FOG/FALL COATINGS

A. Dry Fall, Latex, Flat:[ **MPI #118.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Dry Fall, Water Based, for Galvanized Steel, Flat (Gloss Level 1):[ **MPI #133.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Dry Fall, Alkyd, Flat:[ **MPI #55.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.10 ALUMINUM PAINT

A. Aluminum Paint:[ **MPI #1.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.11 FLOOR COATINGS

A. Stain, Interior, for Concrete Floors:[ **MPI #58.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Sealer, Water Based, for Concrete Floors:[ **MPI #99.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Sealer, Solvent Based, for Concrete Floors:[ **MPI #104.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

D. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3):[ **MPI #60.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

E. Floor Enamel, Alkyd, Gloss (Gloss Level 6):[ **MPI #27.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.12 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements.
4. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials.
5. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  2. Start of painting will be construed as Contractor's acceptance of surfaces and conditions within a particular area.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. Wood: 15 percent.
  4. Gypsum Board: 12 percent.
  5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual"

applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
  2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
  3. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.] [ **but not less than the following:**]
1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
  3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
  4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove loose surface oxidation.



- I. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
  - 5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
  - 6. Seal tops, bottoms, and cutouts of pre-finished wood doors that are undercut or cut in the field.
  
- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
  
- K. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
    - a. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
    - b. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
    - c. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

6. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
  7. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  8. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  9. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer over metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards[ **and switch gear**].
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.

- g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - i. **<Insert mechanical items to be painted>**.
  2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by DEN Project Manager.
    - i. **<Insert mechanical items to be painted>**.
  3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

#### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
  1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing, and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
  3. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

#### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- E. Provide "Wet Paint" signs, warning tape and any other measures required to protect newly painted finishes and prevent the public from encountering freshly painted surfaces.. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
  - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

### 3.6 INTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Nontraffic Surfaces:

##### 1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
- b. Prime Coat: Latex, interior, matching topcoat.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

##### 2. Latex over Latex Aggregate System:

- a. Prime Coat: Textured coating, latex, flat[, **MPI #42**].
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

##### 3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
  - b. Intermediate Coat: Alkyd, interior, matching topcoat.
  - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- B. Concrete Substrates, Traffic Surfaces:
1. Latex Floor Enamel System:
    - a. Prime Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].

- b. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
    - c. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
  2. Alkyd Floor Enamel System:
    - a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
    - b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
    - c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
  3. Concrete Stain System:
    - a. First Coat: Stain, interior, for concrete floors[, **MPI #58**].
    - b. Topcoat: Stain, interior, for concrete floors[, **MPI #58**].
  4. Water-Based Clear Sealer System:
    - a. First Coat: Sealer, water based, for concrete floors[, **MPI #99**].
    - b. Topcoat: Sealer, water based, for concrete floors[, **MPI #99**].
  5. Solvent-Based Clear Sealer System:
    - a. First Coat: Sealer, solvent based, for concrete floors[, **MPI #104**].
    - b. Topcoat: Sealer, solvent based, for concrete floors[, **MPI #104**].
- C. Clay-Masonry Substrates:
  1. Latex System:
    - a. Prime Coat: Latex, interior, matching topcoat.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  2. Latex Aggregate System:
    - a. Prime Coat: Primer for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].
    - b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].
    - c. Topcoat: Textured coating, latex, flat[, **MPI #42**].
  3. Institutional Low-Odor/VOC Latex System:
    - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].

- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
  - b. Intermediate Coat: Alkyd, interior, matching topcoat.
  - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- D. CMU Substrates:
- 1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
  - b. Intermediate Coat: Latex, interior, matching topcoat.
  - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
  - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
  - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
  - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
  - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].



5. Alkyd System:

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
- b. Sealer Coat: Primer sealer, latex, interior[, **MPI #50**].
- c. Intermediate Coat: Alkyd, interior, matching topcoat.
- d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
- e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
- f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
- g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].

E. Steel Substrates:

1. Latex over Alkyd Primer System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
- b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Intermediate Coat: Latex, interior, matching topcoat.
- f. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- g. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- h. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- i. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- j. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- k. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

2. Water-Based Dry-Fall System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
- b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Topcoat: Dry fall, latex, flat[, **MPI #118**].
- f. Topcoat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].

3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based[ **MPI #107**].
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
- d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].

- e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
  - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
  - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
  - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
  - e. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - f. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - g. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - h. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - i. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, rust-inhibitive, water based[ **MPI #107**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
  - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
  - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
  - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
  - e. Intermediate Coat: Alkyd, interior, matching topcoat.
  - f. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - g. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - h. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - i. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].

7. Quick-Drying Enamel System:
    - a. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
    - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
    - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5)[, **MPI #81**].
    - d. Topcoat: Alkyd, quick dry, gloss (Gloss Level 7)[, **MPI #96**].
  
  8. Alkyd Dry-Fall System:
    - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
    - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
    - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
    - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
    - e. Topcoat: Dry fall, alkyd, flat[, **MPI #55**].
  
  9. Aluminum Paint System:
    - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
    - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
    - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
    - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
    - e. Intermediate Coat: Aluminum paint[, **MPI #1**].
    - f. Topcoat: Aluminum paint[, **MPI #1**].
- F. Galvanized-Metal Substrates:
1. Latex over Waterborne Primer System:
    - a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  
  2. Water-Based Dry-Fall System:
    - a. Prime Coat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].
    - b. Topcoat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].
  
  3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating Over Waterborne Primer System:
- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Aluminum Paint System:
- a. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for use on galvanized-metal substrates with topcoat indicated.
  - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
  - c. Topcoat: Aluminum paint[, **MPI #1**].
- G. Aluminum (Not Anodized or Otherwise Coated) Substrates:
1. Latex System:

- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
  - b. Intermediate Coat: Latex, interior, matching topcoat.
  - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
  - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
  - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
  - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
  - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].

5. Alkyd System:
  - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
  - b. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
  - c. Intermediate Coat: Alkyd, interior, matching topcoat.
  - d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
  
6. Aluminum Paint System:
  - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
  - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
  - c. Topcoat: Aluminum paint[, **MPI #1**].
  
- H. Wood Substrates: Including [**wood trim**] [**architectural woodwork**] [**doors**] [**windows**] [**wood-based panel products**] [**glued-laminated construction**] [**exposed joists**] [**exposed beams**] <Insert description>.
  1. Latex System:
    - a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  
  2. Latex over Alkyd Primer System:
    - a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  
  3. Institutional Low-Odor/VOC Latex System:
    - a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
    - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Alkyd System:
- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
  - b. Intermediate Coat: Alkyd, interior, matching topcoat.
  - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- I. Wood Substrates, Traffic Surfaces:
- 1) Latex Floor Paint System:
    - b. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
    - c. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
    - d. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
  - 2. Alkyd Floor Enamel System:
    - a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
    - b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
    - c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
- J. Fiberglass and Plastic Substrates:
- 1. Latex System:

- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
  - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
  - c. Intermediate Coat: Latex, interior, matching topcoat.
  - d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
  - f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
  - g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
  - h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
  - i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
  - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
  - c. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - d. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
  - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
  - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - f. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - g. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
  - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
  - c. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - d. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].



- e. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - f. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
5. Alkyd System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
  - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
  - c. Intermediate Coat: Alkyd, interior, matching topcoat.
  - d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- K. **[Gypsum Board] [Plaster] Substrates:**
1. Latex System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
  - b. Prime Coat: Latex, interior, matching topcoat.
  - c. Intermediate Coat: Latex, interior, matching topcoat.
  - d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
  - f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
  - g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
  - h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
  - i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
  - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
  - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
  - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
  - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
  - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
  - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
  - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
5. Alkyd over Latex Primer System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
  - b. Intermediate Coat: Alkyd, interior, matching topcoat.
  - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- L. Spray-Textured Ceiling Substrates:
- 1. Latex (Flat) System: Spray applied.
    - a. Prime Coat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - b. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - 2. Latex System: Spray applied.
    - a. Prime Coat: Latex, interior, matching topcoat.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  - 3. Latex over Alkyd Primer System:

- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
  - b. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
  - c. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
  - d. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
  - e. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
  - f. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
  - g. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
4. Alkyd (Flat) System:
- a. Prime Coat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - b. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
5. Alkyd System:
- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
  - b. Intermediate Coat: Alkyd, interior, matching topcoat.
  - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
  - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
  - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
  - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- M. **[Cotton or Canvas] [and] [ASJ] Insulation-Covering Substrates: Including [pipe and duct coverings] <Insert description>**.
1. Latex System:
    - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
    - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
    - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
    - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
    - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
    - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
  2. Institutional Low-Odor/VOC Latex System:
    - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
    - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
    - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
    - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].

- f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. Alkyd over Latex Primer System:
    - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
    - b. Intermediate Coat: Alkyd, interior, matching topcoat.
    - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
    - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
    - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
    - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
  4. Aluminum Paint System:
    - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
    - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
    - c. Topcoat: Aluminum paint[, **MPI #1**].

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 099123

## SECTION 099419 - MULTICOLOR INTERIOR FINISHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and field application of multicolor interior coating systems[.] [**applied on the following substrates:**]

1. Vertical concrete.
2. Cementitious composition board.
3. Clay masonry units.
4. Concrete masonry units (CMU).
5. Wood.
6. Fiberglass moldings and trim.
7. Plastic moldings and trim.
8. Plaster.
9. Gypsum veneer plaster.
10. Gypsum board.

- B. Related Requirements:

1. Section 099123 "Interior Painting" for special-use coatings and general field painting.

#### 1.3 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

- B. Installer's Qualifications: Provide evidence of installer's qualifications to apply multicolor paint products, with minimum five (5) years experience.

- C. LEED Submittals:

1. Product Data for Credit EQ 4.2: For coatings systems, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For coating systems, documentation indicating that products comply with the testing and product requirements of the

California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Samples: For each exposed product and for each color and texture specified, **8 inches** (200 mm) square in size.
- E. Samples for Initial Selection: For each multicolor coating system indicated.
- F. Samples for Verification: For each multicolor coating system and in each color, pattern, and pigment density indicated.
  - 1. Submit Samples on rigid backing, **8 inches** (200 mm) square.
  - 2. Label each Sample for location and application area.
- G. Product Schedule: For multicolor coating systems. [ **Use same designations indicated on Drawings.**]

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: [**5**] **<Insert number>** percent, but not less than [**1 gal.** (3.8 L)] **<Insert number>** of each material and color application.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockup of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. DEN Project Manager will select one surface to represent surfaces and conditions for application of each coating system and type of substrate.
    - a. Wall Surfaces: Provide samples of at least **100 sq. ft.** (9 sq. m).
    - b. Other Items: DEN Project Manager will designate items or areas required.
  - 2. Apply mockup after permanent lighting and other environmental services have been activated.
  - 3. Final approval of color and pattern selections will be based on mockup.
    - a. If preliminary color and pattern selections are not approved, apply additional mockups of colors and patterns selected by DEN Project Manager at no added cost to Owner.
  - 4. Repair Mockup: After approval of color and pattern selections, apply representative repairs to **100 sq. in.** (65 sq. cm) of mockup to establish quality

- standards for coating system repairs.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
  6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply coatings until spaces are enclosed and weatherproof, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 MULTICOLOR COATING SYSTEMS, GENERAL

- A. Master Painters Institute (MPI) Standards: Comply with recommendations in "MPI Architectural Painting Specification Manual" applicable to products and coating systems indicated.
- B. Material Compatibility: Provide materials for use within each coating system that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction[ **and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].
  1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
  2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
  3. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
  4. Clear Wood Finishes and Varnishes: VOC content of not more than 350 g/L.
- D. Low-Emitting Materials: Provide multicolored coating products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources

Using Small-Scale Environmental Chambers."

- E. Colors and Patterns: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in finish schedule] <Insert requirements>**.

## 2.2 FILLERS AND PRIMERS

- A. General: Undercoatings recommended in writing for use in coating systems by manufacturer of multicolor interior coating on substrates and under conditions indicated.
- B. Latex Block Filler: Waterborne, high-solids, emulsion-type, pigmented coating product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, with bridging and filling properties, and formulated for filling surfaces of CMU for subsequent applications of finish coatings.
- C. Wood Filler Paste: Solvent-based, high-solids, clear paste product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, for use on open-grained or damaged woods. The paste fills hardwood pores with minimal surface residues and without showing cracking or shrinkage. When dry, sanding filler produces a smooth surface without clogging or gumming sandpaper.
- D. Wood-Knot Sealer: White shellac or other sealer recommended in writing for this purpose by manufacturer of multicolor interior coating.
- E. Primer/Sealer for Multicolor Systems: Acrylic or acrylic/polyvinyl acetate (PVA) co-polymer emulsion-type, pigmented primer/sealer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating.
- F. Interior Alkyd Primer/Sealer: Solvent-based, pigmented primer/sealer.
- G. Water-Based Bonding Primer: Water-based, emulsion-type, pigmented primer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings.
- H. Solvent-Based Bonding Primer: Solvent-based, pigmented product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings to substrate.

## 2.3 MULTICOLOR COATINGS

- A. Multicolor Coating: Water- or solvent-based coat that provides a decorative polychromatic finish. **[ Complying with MPI #112 and listed in "MPI Approved Products List." ]**
  - 1. Products: Subject to compliance with requirements, provide one of the following:



- a. Crafton Coatings, Bollen International, Inc.; **[Crafton] [Crafton Plus] [Ferroxtone]**.
  - b. Duron, Inc.; Vara-Flic, Int. Waterborne Multicolor Finish.
  - c. Multicolor Specialties, Inc.; Multispec **[Colorspec] [Duraspec] [WaterColors] [Fine Fleck]**.
  - d. Seagrave Coatings Corp.; Plextone.
  - e. Zolatone Interior Finishes, Master Coating Technologies; **[Luminations] [Polomyx] [Polomyx Airless]**.
  - f. **<Insert manufacturer's name; product name or designation>**.
  - g. or approved equal.
- B. Clear Topcoat: Product recommended by multicolor coating manufacturer for use in multicolor coating system indicated to add surface abrasion and detergent resistance; water-based, clear acrylic co-polymer emulsion or solvent-based, clear acrylic solution binder. **[Complying with MPI #121 and listed in "MPI Approved Products List."]**
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Benjamin Moore; Benwood, Stays Clear Acrylic Polyurethane Low Lustre.
    - b. Columbia Paint & Coatings; Multi-Spec, Clear.
    - c. Coronado Paint; Aqua-Plastic Waterborne Urethane.
    - d. PPG Architectural Finishes, Inc.; **[Olympic, Premium Interior Water Based Polyurethane Clear] [Rez, Interior Acrylic Polyurethane Gloss]**.
    - e. **<Insert manufacturer's name; product name or designation>**.
    - f. or approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of coatings.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
    - b. Masonry (Clay and CMU): 12 percent.
    - c. Wood: 15 percent.
    - d. Plaster: 12 percent.
    - e. Gypsum Veneer Plaster: 12 percent.
    - f. Gypsum Board: 12 percent.
  2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
  3. Plaster Substrates: Verify that plaster is fully cured.
  4. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

5. Begin coating application only after unsatisfactory conditions have been corrected.
6. Beginning coating application indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
  1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible primers, paints, and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Wood Substrates:
  1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of knot sealer before applying primer.
  2. Sand surfaces that will be exposed to view; remove sanding dust from surfaces to be coated.
  3. Prime edges, ends, faces, undersides, and backsides of wood.
  4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried and remove sanding dust.

### 3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions using applicators and techniques suited for coating and substrate indicated.
- B. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
- C. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

- D. Apply coating systems to produce uniformly textured, colored, and patterned finished-surface films without substrates, undercoats, marks, or stains showing through. Produce sharp, even glass lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper applicators and techniques for repairing multicolored interior coating systems on substrates indicated.
  - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

### 3.6 MULTICOLOR INTERIOR COATING SCHEDULE

- A. Vertical Concrete Substrates:
  - 1. Prime Coat: Primer/sealer for multicolor systems.
  - 2. Multicolor Base Coat: Multicolor coating.
  - 3. Multicolor Pattern Coat: Multicolor coating.
  - 4. Topcoat: Clear topcoat.
- B. Cementitious Composition Board Substrates:
  - 1. Prime Coat: Primer/sealer for multicolor systems.
  - 2. Multicolor Base Coat: Multicolor coating.
  - 3. Multicolor Pattern Coat: Multicolor coating.
  - 4. Topcoat: Clear topcoat.
- C. Clay Masonry Unit Substrates:
  - 1. Prime Coat: Primer/sealer for multicolor systems tinted to match multicolor basecoat.

2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

D. CMU Substrates:

1. Block Filler: Latex block filler.
2. Prime Coat: Primer/sealer for multicolor systems.
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.
5. Topcoat: Clear topcoat.

E. Wood Substrates:

1. Fill Coat: Wood filler paste.
2. Prime Coat: Interior alkyd primer/sealer [ **tinted to match multicolor base coat**].
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.
5. Topcoat: Clear topcoat.

F. Fiberglass Molding and Trim Substrates:

1. Prime Coat: [**Water**] [**Solvent**]-based bonding primer.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

G. Plastic Molding and Trim Substrates:

1. Prime Coat: Solvent-based bonding primer.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

H. [**Plaster**] [**Gypsum Veneer Plaster**] [**Gypsum Board**] Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 099419

## SECTION 142100 - ELECTRIC TRACTION ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes electric traction [**passenger**] [**and**] [**service**] elevators.
- B. Related Requirements:
  - 1. Section 015210 "Temporary Facilities" for temporary use of elevators for construction purposes.
  - 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
  - 4. Section 051200 "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
  - 5. Section 055000 "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
    - e. Pit ladders.
    - f. Cants in hoistways made from steel sheet.
  - 6. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
  - 7. Section 057000 "Decorative Metal" for combination hall push-button stations.
  - 8. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
  - 9. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.

10. <Insert Section number>-<Insert Section title> for finish flooring in elevator cars.
11. Section 142113 "Electric Traction Freight Elevators" for electric traction elevators used primarily for carrying freight and inaccessible to the general public.
12. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
13. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators[ **and for Internet connection to elevator controllers for remote monitoring of elevator performance**].
14. [Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop)] Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation[ **and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.

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

### 1.3 REFERENCES

- A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

- B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

- C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

- D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

- E. U.S. Architectural & Transportation Barriers Compliance Board:

1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA),

Accessibility Guidelines for Buildings and Facilities.

1.4 ALLOWANCES

- A. Elevator Car Allowances: Provide finished passenger[ **and service**] elevator cars under the Elevator Car Allowance specified in Section 012100 "Allowances."  
Allowance includes furnishing and installing the following:

1. Car wall finishes including trim.
2. Car floor finishes.
3. Car ceiling finishes.
4. Car[ **and hoistway**] door finishes.
5. Car doorsills.
6. Car light fixtures.
7. Handrails.
8. Cutouts and other provisions for installing elevator signal equipment in cars.

1.5 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.
- C. Electric Traction Elevators: Elevators in which cars are hoisted by wire ropes using electrically driven traction sheaves and are defined to include driving machines; cars; hoistway doors; guide rails; guide-rail brackets; roping; buffers; counterweights; signals; control systems; electrical wiring within elevator system; and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.
1. Counterweight displacement switches, seismic switch, and other elevator safety equipment required by the "Code" for seismic risk zone 2 or greater are included.
- D. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.6 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:



1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
3. Include large-scale layout of car-control station[ **and standby power operation control panel**].

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; **3-inch**- (75-mm-) square Samples of sheet materials; and **4-inch** (100-mm) lengths of running trim members.

## 1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and **[machine room] [control closet]** layout and dimensions, as shown on Drawings, and electrical service[ **including standby power generator**], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

## 1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
  - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to DEN Project Manager, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

#### 1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
  - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off ground, under cover, and in a dry location.

### 1.12 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

### 1.13 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Minimum 12 months <Insert number> year(s) from date of Substantial Completion.

### 1.14 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ThyssenKrupp
  - 2. Dover Elevator Corp.

3. KONE Inc.
4. Otis Elevator Co.
5. Schindler Elevator Corp.
6. U.S. Elevator.
7. <Insert manufacturer's name>.
8. or approved equal.

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement> and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[ **and the system will be fully operational after the seismic event**]."
2. Affected peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk Zones 0 and 1)**] [**greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)**] [**greater than or equal to 0.20 (seismic risk Zones 3 and 4)**].
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is <Insert value>.
6. Project Seismic Design Category: [A] [B] [C] [D] [E] [F].
7. Elevator Component Importance Factor: [1.5] [1.0].

## 2.3 MATERIALS AND COMPONENTS, GENERAL

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.

B. Elevator Machines: (Geared) (Gearless) type.

1. At manufacturer's option, provide either variable-voltage, variable-frequency ac-type hoisting machine or variable-voltage dc type.
  2. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide variable-voltage geared machine.
  3. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide geared machine with ac-type single-speed or 2-speed motor as indicated.
- C. Power Control: Except as otherwise indicated, where variable voltage is required, provide solid-state power converters for use with motors on elevator machines (ac or dc).
1. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- D. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- F. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 for materials and fabrication.
- G. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- H. Car Frame and Platform: Welded steel units.

## 2.4 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
1. Group Number: **<Insert a different number for each group of elevators that share a group operation system>**.
  2. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  3. Emergency Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  4. Service Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  5. Machine Location: **[Machine room above hoistway] [Hoistway; no machine room is provided]**.
  6. Machine Type: **[Geared] [Gearless]** traction.

7. Rated Load: [2000 lb (908 kg)] [2100 lb (953 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [3500 lb (1589 kg)] [4000 lb (1816 kg)] [4500 lb (2043 kg)] [5000 lb (2270 kg)] **<Insert value>**.
8. Freight Loading Class for Service Elevator(s): Class A.
9. Rated Speed: [200 fpm (1.0 m/s)] [350 fpm (1.8 m/s)] [400 fpm (2.0 m/s)] [450 fpm (2.3 m/s)] [500 fpm (2.5 m/s)] [700 fpm (3.6 m/s)] [800 fpm (4.1 m/s)] [1000 fpm (5.1 m/s)] [1200 fpm (6.1 m/s)] [1400 fpm (7.1 m/s)] **<Insert value>**.
10. Operation System: [**Selective-collective automatic operation**] [**Group automatic operation**] [**Group automatic operation with demand-based dispatching**] [**Destination-based group automatic operation**].
11. Auxiliary Operations:
  - a. Standby power operation.
  - b. Standby-powered lowering.
  - c. Battery-powered lowering.
  - d. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
  - e. Automatic dispatching of loaded car.
  - f. Nuisance call cancel.
  - g. [**Emergency hospital**] [**Priority**] service at [all] **<Insert floor designations>** floors.
  - h. Independent service for [**service elevator**] [**one car in group**] [**all cars in group**].
  - i. Loaded-car bypass.
  - j. Distributed parking.
12. Security Features: [**Card-reader operation**] [**Keyswitch operation**] [**Keypad operation**] [**Car-to-lobby feature**].
13. Dual Car-Control Stations: Provide two car-control stations[ **in each elevator**]; equip only one with required keyswitches if any.
14. Car Enclosures:
  - a. Inside Width: [64 inches (1626 mm)] [68 inches (1727 mm)] [80 inches (2032 mm)] [92 inches (2337 mm)] **<Insert dimension>** from sidewall to sidewall.
  - b. Inside Depth: [51 inches (1295 mm)] [53 inches (1346 mm)] [57 inches (1448 mm)] [65 inches (1651 mm)] [87-1/2 inches (2222 mm)] [90 inches (2286 mm)] [93 inches (2362 mm)] [93-1/2 inches (2375 mm)] [96 inches (2438 mm)] [101 inches (2565 mm)] [102 inches (2591 mm)] **<Insert dimension>** from back wall to front wall (return panels).
  - c. Inside Height: [88 inches (2235 mm)] [92 inches (2337 mm)] [94 inches (2388 mm)] [100 inches (2540 mm)] [104 inches (2642 mm)] [108 inches (2743 mm)] [112 inches (2845 mm)] **<Insert dimension>** to underside of ceiling.
  - d. Front Walls (Return Panels): [**Polished stainless steel, No. 8 finish**] [**Satin stainless steel, No. 4 finish**] [**Polished bronze, lacquered**] [**Satin bronze, lacquered**].
  - e. Car Fixtures: [**Polished stainless steel, No. 8 finish**] [**Satin stainless steel, No. 4 finish**] [**Polished bronze, lacquered**] [**Satin bronze, lacquered**].

- f. Side and Rear Wall Panels: [Enameled steel] [Plastic laminate] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Satin bronze, lacquered].
  - g. Reveals: [Enameled steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
  - h. Door Faces (Interior): [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
  - i. Doorsills: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
  - j. Ceiling: [Luminous ceiling] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Reflective metallic-finish, plastic-laminate, stainless steel] [Reflective metallic-finish, plastic-laminate, bronze].
  - k. Handrails: [1-1/2 inches (38 mm) round] [1/2 by 2 inches (13 by 50 mm) rectangular] <Insert dimension> [mirror-polished stainless steel, No. 8 finish] [satin stainless steel, No. 4 finish] [mirror-polished bronze, lacquered] [satin bronze, lacquered], at [sides] [and] [rear] of car.
  - l. Floor: Manufacturer's standard carpet.
  - m. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").
  - n. Floor prepared to receive resilient flooring (specified in Section 096500 "Resilient Flooring").
  - o. Floor recessed and prepared to receive [dimension stone tile (specified in Section 093033 "Stone Tiling")] [ceramic tile (specified in Section 093000 "Tiling")].
  - p. Floor Thickness, Including Setting Materials: <Insert thickness> above plywood subfloor.
15. Hoistway Entrances:
- a. Width: [36 inches (914 mm)] [42 inches (1067 mm)] [48 inches (1219 mm)] [54 inches (1372 mm)] <Insert dimension>.
  - b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>.
  - c. Type: [Single-speed side sliding] [Two-speed side sliding] [Single-speed center opening] [Two-speed center opening].
  - d. Frames [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
  - e. Frames at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
  - f. Doors[ and Transoms] [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
  - g. Doors[ and Transoms] at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4

- finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
- h. Sills [at First Floor] [at Basement Floors]: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
  - i. Sills at Other Floors: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
16. Hall Fixtures [at First Floor] [at Basement Floors]: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces].
17. Hall Fixtures at Other Floors: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces].
18. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from [polished stainless steel, No. 8 finish] [satin stainless steel, No. 4 finish] [polished bronze, lacquered] [satin bronze, lacquered].
  - b. Provide hooks for protective pads [in all cars] and [one] [two] <Insert number> complete set(s) of full-height protective pads.

## 2.5 TRACTION SYSTEMS

- A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines [or variable-voltage dc-type hoisting machines] and solid-state power converters.
- 1. Provide [regenerative] [or] [nonregenerative] system.
  - 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
  - 3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
  - 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Bolted- or welded-steel units.
- F. Guides: [Roller guides] [or] [polymer-coated, nonlubricated sliding guides]. Provide guides at top and bottom of car and counterweight frames.



## 2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Group Automatic Operation with Demand-Based Dispatching: Provide[ **reprogrammable**] group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger [**waiting time**] [**time to destination**]. System automatically adjusts to demand changes for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
- Products: Subject to compliance with requirements, provide one of the following:
    - ThyssenKrupp
    - Dover Elevator Corp.
    - KONE Inc.; KCM 831.
    - Otis Elevator Co.; Elevonic.
    - Schindler Elevator Corp.; Miconic TX.
    - U.S. Elevator.
    - <Insert manufacturer's name; product name or designation>**.
    - or approved equal.
- C. Destination-Based Group Automatic Operation: Provide reprogrammable group automatic system that assigns elevators leaving the main lobby in the up direction to a selected group of floors and directs passengers to an elevator serving their destination floor. System dispatches cars in a regulated sequence for optimum system efficiency; dispatch is based on origin and destination of calls. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
- Products: Subject to compliance with requirements, provide one of the following:
    - KONE Inc.; Polaris Destination Control.
    - Otis Elevator Co.; Elevonic with Channeling Operation.
    - Schindler Elevator Corp.; Miconic 10.
    - <Insert manufacturer's name; product name or designation>**.
    - or approved equal.
- D. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
- Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at [**main lobby**] [**fire command station**] **<Insert location>**. Manual operation causes automatic operation to cease.
  - Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is

- between floors, it is lowered to the next floor below, opens its doors, and shuts down.
3. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
  4. Group Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
  5. Group Standby Power Operation: On activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at **[main lobby] [fire command station] <Insert location>**.
  6. Group Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered one at a time to the next floor below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
  7. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
  8. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls **[ and predetermined weight]** can be adjusted.
  9. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
  10. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed and distributed in predetermined zones throughout the building. One zone shall include the main floor and adjacent floors; remaining floors shall be divided into approximately equal zones.
  11. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
  12. **[Emergency Hospital] [Priority] Service: Service is initiated by a [keyswitch] [card reader] [remote switch] at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks [ and a lighted sign directs passengers to exit elevator]. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.**

13. Earthquake emergency operation.
  14. Fire recall position
- E. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Card-Reader Operation: System uses card readers at **[car-control stations]** **[and]** **[hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car.
    - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
    - b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**
  2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
    - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
  3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable **[only in deactivated position]**.
  4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamplights and remains lit until landing access code has been entered or predetermined time period has elapsed.
  5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
  6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
  - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.8 CAR ENCLOSURES

- A. General: Provide **[enameled-steel car enclosures to receive removable] [steel-framed car enclosures with nonremovable]** wall panels, with **[removable]** car roof, access doors, power door operators, and ventilation.
  1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
  2. See "Allowances" Paragraph in "Summary" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car **[including materials and finishes specified below]**.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
  1. Subfloor: Exterior, underlayment grade plywood, not less than **5/8-inch** (15.9-mm) nominal thickness.
  2. Subfloor: Exterior, C-C Plugged grade plywood, not less than **7/8-inch** (22.2-mm) nominal thickness.
  3. Floor Finish: **[Specified in <Insert Section number>-<Insert Section title>] [Elevator manufacturer's standard level-loop nylon carpet; color as selected by DEN Project Manager from full range of industry colors]**.

4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
7. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to **[1/2-inch (13-mm) fire-retardant-treated particleboard]** **[manufacturer's standard honeycomb core]** with **[plastic-laminate panel backing and]** manufacturer's standard protective edge trim. Panels have a flame-spread index of **[25]** **[75]** or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from **[plastic-laminate]** **[elevator]** manufacturer's full range.
8. Fabricate car with recesses and cutouts for signal equipment.
9. Fabricate car doorframe integrally with front wall of car.
10. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
11. Primed-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied, rust-resistant primer for field painting.
12. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet]** **[or]** **[by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning].**
13. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
14. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim **[matching return panels]**. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from **[plastic-laminate]** **[elevator]** manufacturer's full range.
15. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
16. Sight Guards: Provide sight guards on car doors.
17. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
18. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
19. **[Metal]** **[Metallic-Finish, Plastic-Laminate]** Ceiling: Flush panels, with **[incandescent downlights in the center of]** **[four low-voltage downlights in]** each panel. **[Align ceiling panel joints with joints between wall panels.]**
20. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

## 2.9 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to **[NFPA 252]** **[or]** **[UL 10B]**.
- Fire-Protection Rating: **[1 hour]** **[1-1/2 hours]** **<Insert rating>** **[ with 30-minute temperature rise of 450 deg F (250 deg C)]**.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
- Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
  - Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
  - Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
  - Stainless-Steel Frames: Formed from stainless-steel sheet.
  - Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
  - Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than **3 inches** (76 mm) high, on both inside surfaces of hoistway doorframes.
  - Enameled-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
  - Primed-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
  - Stainless-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet]** **[or]** **[by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning]**.
  - Bronze Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
  - Plastic-Laminate Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled

- cold-rolled steel doors and covering edges with protective edge trim[ **matching doorframes**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
12. Unfinished-Steel Doors[ **and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
  13. Sight Guards: Provide sight guards on doors matching door edges.
  14. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
  15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

## 2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- B. General: Provide signal equipment designed for destination-based system. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- C. Car-Control Stations: Provide manufacturer's standard [**recessed**] [**or**] [**semirecessed**] car-control stations. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount in return panel adjacent to car door unless otherwise indicated.
  1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Swing-Return Car-Control Stations: Provide car control station fully recessed in hinged return panel adjacent to door of each car. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mark other buttons and switches with manufacturer's standard identification for required use or function.
  1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
  3. Mount controls as shown or scheduled and at heights complying with ANSI A117.1.
  4. Mount controls as shown or scheduled and at heights complying with ADA Accessibility Guidelines.
  5. Provide 2 car control stations in each passenger elevator; equip only 1 with required keyswitches, if any.

- E. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.
- F. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- G. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- H. Car Position Indicator: Provide [**illuminated,**] digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- I. Hall Push-Button Stations: [[**Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group**] [**Provide hall push-button stations at each landing as indicated**]. For each group of passenger elevators, locate between 2 elevators at center of group or at location most convenient for approaching passengers.
1. Provide [**units with flat faceplate for mounting with body of unit recessed in wall**].
  2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
  3. Provide 2-button stations at intermediate landings. Provide 1-button stations with direction indication at terminal landings.
  4. Equip units with [**buttons**] [**or**] [**touch screen**] for calling elevator and for indicating direction of travel or destination as required by system. Provide a signaling system to verify floor selection, where destination registration is required, and to direct passengers to appropriate car.
    - a. Provide a means for passengers to indicate that they have disabilities so control system can allow extra room in assigned car.
    - b. Provide for connecting units that require destination registration to building security access system so a card reader can be used to register calls.



- J. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
1. Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.
- K. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Match materials, finishes, and mounting method of hall push-button stations. Provide[ **one of**] the following:
1. Place lanterns either above or beside each hoistway entrance, unless otherwise shown. Mount at minimum of 72 inches (1829 mm) above finished floor.
  2. Place lanterns in both jambs of entrance frame for each elevator. Mount at minimum of 72 inches (1829 mm) above finished floor.
  3. At manufacturer's option, for single elevators or for only 2 cars in a group, lanterns may be located in car door jambs instead of entrance jambs.
  4. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
  5. At manufacturer's option, audible signals may be placed on each car.
- L. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
1. At manufacturer's option, audible signals may be placed on cars.
- M. Hall Position Indicators: Provide [**illuminated,**] digital-display-type position indicators, located above each hoistway entrance at ground floor. Match materials, finishes, and mounting method of hall push-button stations.
1. Integrate ground-floor hall lanterns with hall position indicators.
- N. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.[ **For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.**]
- O. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

- P. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## 2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.
  2. Metal surface is [satin polished] [satin relieved] [titanium nitride colored] [oxide colored] [satin polished and titanium nitride colored] [satin relieved and titanium nitride colored] [satin polished and oxide colored] [satin relieved and oxide colored] [color coated and satin relieved] [color coated and bright relieved] after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
- I. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- J. Bronze Tubing: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- K. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), Alloy 6063.
- L. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- M. Plastic Laminate: High-pressure type complying with NEMA LD 3, [Type HGS for flat applications] [Type HGL for flat applications] [Type HGP for postformed applications] [and] [Type BKV for panel backing].

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions and recommendations.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators. Comply with Section 059990 "Welding".
- C. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- E. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance:  $\frac{1}{8}$  inch (3 mm), up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of **72 inches** (1829 mm) above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load [**elevator**] [**each elevator**] [**one elevator of each type, capacity, speed, and travel distance**] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for [**each**] elevator used for construction purposes:
  1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  2. Provide strippable protective film on entrance and car doors and frames.
  3. Provide padded wood bumpers on entrance doorframes covering jambs and frame faces.
  4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
    - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
  5. Do not load elevators beyond their rated weight capacity.
  6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation

at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
  1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
  2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[ **each**] elevator with DEN Project Manager's personnel present before date of Substantial Completion[ **and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

### 3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 <Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 142100

## SECTION 142113 - ELECTRIC TRACTION FREIGHT ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes electric traction freight elevators.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
  - 3. Section 051200 "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills[ **and hoistway doorframes**] that are part of steel frame.
  - 4. Section 055000 "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for [**subsills**] [**and**] [**hoistway doorframes**].
    - e. Pit ladders.
    - f. Cants in hoistways made from steel sheet.
  - 5. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
  - 6. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
  - 7. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.

8. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators[ **and for Internet connection to elevator controllers for remote monitoring of elevator performance**].
9. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation[ **and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.

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

### 1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

E. U.S. Architectural & Transportation Barriers Compliance Board:

1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

### 1.4 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.



- B. Electric Traction Elevators: Elevators in which cars are hoisted by wire ropes using electrically driven traction sheaves and are defined to include driving machines; cars; hoistway doors; guide rails; guide-rail brackets; roping; buffers; counterweights; signals; control systems; electrical wiring within elevator system; and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.
  - 1. Counterweight displacement switches, seismic switch, and other elevator safety equipment required by the "Code" for seismic risk zone 2 or greater are included.
- C. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and **[machine room]** **[control closet]** layout and dimensions, as shown on

Drawings, and electrical service[ **including standby power generator**], as shown and specified, are adequate for elevator system being provided.

- D. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage.
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
  - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to DEN Project Manager, in the form of a standard [**one-year**] [**two-year**]

[five-year] <Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
  - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.11 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to electric traction freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

## 1.12 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Minimum 12 months <Insert number> year(s) from date of Substantial Completion.

## 1.13 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dover Elevator Corp.
  2. KONE Inc.
  3. Otis Elevator Co.
  4. U.S. Elevator
  5. **<Insert manufacturer's name>**.
  6. or approved equal.
- B. Source Limitations: Obtain freight elevators from single manufacturer.
1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>** and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified **[ and the system will be fully operational after the seismic event].**"
  2. Affected peak velocity acceleration (Av) for Project's location is **[less than 0.10 (seismic risk Zones 0 and 1)] [greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)] [greater than or equal to 0.20 (seismic risk Zones 3 and 4)].**
  3. Provide earthquake equipment required by ASME A17.1/CSA B44.
  4. Provide seismic switch required by ASCE/SEI 7.

5. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

## 2.3 MATERIALS AND COMPONENTS, GENERAL

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.
- B. Elevator Machines: (Geared) (Gearless) type.
  1. At manufacturer's option, provide either variable-voltage, variable-frequency ac-type hoisting machine or variable-voltage dc type.
  2. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide variable-voltage geared machine.
  3. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide geared machine with ac-type single-speed or 2-speed motor as indicated.
- C. Power Control: Except as otherwise indicated, where variable voltage is required, provide solid-state power converters for use with motors on elevator machines (ac or dc).
  1. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- D. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- F. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 for materials and fabrication.
- G. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- H. Car Frame and Platform: Welded steel units.

## 2.4 FREIGHT ELEVATORS

- A. Elevator System, General: Manufacturer's standard electric traction freight elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): <Insert elevator number(s) as shown on Drawings>.
2. Elevator Type: **[Geared]** **[Gearless]** traction.
3. Machine Location: **[Machine room above hoistway]** **[Hoistway; no machine room is provided]**.
4. Rated Load: **[2000 lb (908 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [4000 lb (1816 kg)] [5000 lb (2270 kg)] [6000 lb (2720 kg)] [8000 lb (3632 kg)] [10,000 lb (4540 kg)]** <Insert value>.
5. Freight Loading Class: **[Class A]** **[Class B]** **[Class C1]** **[Class C2]** **[Class C3]**.
6. Rated Speed: **[75 fpm (0.38 m/s)] [100 fpm (0.51 m/s)] [150 fpm (0.76 m/s)] [200 fpm (1.0 m/s)] [350 fpm (1.8 m/s)]** <Insert value>.
7. Operation System: **[Single automatic]** **[Car-switch automatic floor stop]** **[Selective-collective automatic]**.
8. Auxiliary Operations:
  - a. Standby power operation.
  - b. Earthquake emergency operation.
  - c. Load-weighing device.
9. Security Feature: **[Card-reader]** **[Keyswitch]** operation.
10. Auxiliary Car-Control Station: Provide additional car-control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
11. Car Enclosures:
  - a. Platform Width: **[64 inches (1626 mm)] [76 inches (1930 mm)] [88 inches (2235 mm)] [100 inches (2540 mm)]** <Insert dimension>.
  - b. Platform Depth: **[84 inches (2134 mm)] [96 inches (2438 mm)] [120 inches (3048 mm)] [144 inches (3658 mm)] [168 inches (4267 mm)]** <Insert dimension>.
  - c. Ceiling Height: **[84 inches (2134 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)]** <Insert dimension>.
  - d. Walls and Ceiling: **[Prime-painted steel]** **[Prime-painted, metallic-coated steel]** **[Satin stainless steel, No. 4 finish]** **[Textured stainless steel]**.
  - e. Car Fixtures: Satin stainless steel, No. 4 finish.
  - f. Floor: **[Rolled steel floor plate]** **[Aluminum-alloy rolled tread plate]** **[Rolled stainless-steel floor plate]** <Insert material>.
  - g. Car Gate Type: **[Vertical biparting]** **[Single-speed vertical lift]** **[Two-speed vertical lift]**.
  - h. Car Gate Operation: **[Manual]** **[Power operated]**.
  - i. Car Gate Material: **[Prime-painted steel]** **[Satin stainless steel, No. 4 finish]**.
  - j. Car Sill: Steel angle.
  - k. Lighting: **[One]** **[Two]** **[Three]** **48-inch (1219-mm)**, **[suspended,]** **[surface-mounted,]** two-tube fluorescent light fixture(s) with **[white reflectors]** **[and]** **[wire lamp guards]**.
  - l. Lighting: **[One]** **[Two]** **48-inch (1219-mm)**, recessed, **[two]** **[three]**-tube fluorescent light fixture(s) with UV-stabilized acrylic diffusers not less than **0.125 inch (3.2 mm)** thick.

12. Hoistway Entrances:
- a. Width: [60 inches (1524 mm)] [72 inches (1829 mm)] [96 inches (2438 mm)] **<Insert dimension>**.
  - b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] **<Insert dimension>**.
  - c. Door Type: [**Vertical biparting**] [**Single-speed vertical lift**] [**Two-speed vertical lift**].
  - d. Fire-Protection Rating: [1 hour] [1-1/2 hours] **<Insert rating>**[ with **30-minute temperature rise of 450 deg F (250 deg C)**].
  - e. Door Operation: [**Manual**] [**Power operated**].
  - f. Door Material: [**Prime-painted steel**] [**Satin stainless steel, No. 4 finish**].
  - g. Doorframe Material: [**Prime-painted steel**] [**Satin stainless steel, No. 4 finish**].
  - h. Door[ **frames and**] sills are specified in [**Section 051200 "Structural Steel Framing"**] [**Section 055000 "Metal Fabrications."**]
13. Hall Fixtures: Satin stainless steel, No. 4 finish.
14. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations[ **where indicated**], mounted at height to facilitate operation by forklift-truck operator without leaving truck.
15. Additional Requirements:
- a. Door reopening device.

## 2.5 TRACTION SYSTEMS

- A. Elevator Machines: At manufacturer's option, provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.
1. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
  2. Provide means for absorbing regenerated power when elevator system is operating on standby power.
  3. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Welded[ **or bolted**]-steel units.

1. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.

F. Guides: **[Roller guides] [or] [polymer-coated, nonlubricated sliding guides]**. Provide guides at top and bottom of car and counterweight frames.

## 2.6 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power by a switch in control panel located at **[main lobby] [fire command station] <Insert location>**.

C. Group Standby Power Operation: On activation of standby power, cars are returned one car at a time to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch in the control panel located at **[main lobby] [fire command station] <Insert location>**.

D. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.

E. Fire recall position.

F. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal lamp lights and remains lit in the car-control station; when car load exceeds rated capacity, car does not respond to car or hall calls.

G. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at **[car-control stations] [and] [hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. **[Allow space as indicated for card reader in car] [Provide stripe-swipe card reader integral with each car-control station]**.

a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.

b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**

2. Card-reader operation for access to restricted landings based on security system



provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.

- a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at [**car-control stations**] [**and**] [**hall push-button stations**]. Key is removable [**only in deactivated position**] [**in either position**].
4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamp lights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

## 2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with a uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

## 2.8 CAR ENCLOSURES

- A. General: Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.
  1. Provide power door operators with linkages for hoistway door operation.
  2. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than **0.067 inch** (1.7 mm) and reinforced at **16-inch** (406-mm) maximum spacing.

1. Provide perforated panels for ceiling and for walls above **72 inches** (1829 mm) from car floor, unless required to be solid by ASME A17.1/CSA B44.

## 2.9 HOISTWAY ENTRANCES

- A. General: Structural-steel frames and sills for hoistway entrances are specified in **[Section 051200 "Structural Steel Framing"] [Section 055000 "Metal Fabrications."]**
- B. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.
  1. Equip for power operation by coordinated linkage with power-operated car door.
  2. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.
- C. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close-to-neutral pressure as possible according to **[NFPA 252] [or] [UL 10B]**.
- D. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
  1. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than **24 inches** (610 mm) o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than **0.097 inch** (2.5 mm) thick.

## 2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.
- B. Car-Control Stations: Provide manufacturer's standard car-control station. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount adjacent to car door unless otherwise indicated.
  1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  2. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will

provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- D. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283113 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- E. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened
- F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station.
- G. Hall Push-Button Stations: Provide hall push-button station at each landing as indicated.
  - 1. Provide single-button stations with [**position**] [**"in-use"**] indicator.
- H. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283113 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

## 2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, commercial steel, with **G60** (Z180) zinc coating (galvanized) or **A60** (ZF180) zinc-iron-alloy coating (galvannealed).
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- F. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
  - 1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.

- G. Stainless-Steel Bars: ASTM A 276, Type 304.
- H. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- I. Rolled Steel Floor Plate: ASTM A 786/A 786M.
- J. Rolled Stainless-Steel Floor Plate: ASTM A 793.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Pattern 1, Alloy 6061-T6.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- E. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final

adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load [**elevator**] [**each elevator**] [**one elevator of each type, capacity, speed, and travel distance**] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for [**each**] elevator used for construction purposes:
  - 1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 2. Do not load elevators beyond their rated weight capacity.
  - 3. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
  - 1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational

- failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

- B. Check operation of[ **each**] elevator with DEN Project Manager's personnel present and before date of Substantial Completion[ **and not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

### 3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<**Insert number**> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
1. Perform maintenance during normal working hours.
  2. Perform emergency callback service during normal working hours with response time of [**two**] <**Insert number**> hours or less.
  3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [**two**] <**Insert number**> hours or less.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 142113

## SECTION 142400 - HYDRAULIC ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes hydraulic [**passenger**] [**and**] [**service**] elevators.
- B. Related Requirements:
  - 1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
  - 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
  - 4. Section 051200 "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills that are part of steel frame.
  - 5. Section 055000 "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
    - e. Pit ladders.
    - f. Cants in hoistways made from steel sheet.
  - 6. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
  - 7. Section 057000 "Decorative Metal" for combination hall push-button stations.
  - 8. **<Insert Section number>-<Insert Section title>** for finish flooring in elevator cars.
  - 9. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.

10. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
11. Section 142413 "Hydraulic Freight Elevators" for hydraulic elevators used primarily for carrying freight and inaccessible to the general public.
12. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
13. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
14. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation **[ and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation]** and for connection to elevator controllers.
15. Section 31200 "Earth Moving" for excavating well hole to accommodate cylinder assembly.

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

### 1.3 REFERENCES

- A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

- B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

- C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

- D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

- E. U.S. Architectural & Transportation Barriers Compliance Board:



1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

#### 1.4 ALLOWANCES

- A. Elevator Car Allowances: Provide finished passenger[ **and service**] elevator cars under the Elevator Car Allowance specified in Section 012100 "Allowances."  
Allowance includes furnishing and installing the following:
  1. Car wall finishes including trim.
  2. Car floor finishes.
  3. Car ceiling finishes.
  4. Car[ **and hoistway**] door finishes.
  5. Car doorsills.
  6. Car light fixtures.
  7. Handrails.
  8. Cutouts and other provisions for installing elevator signal equipment in cars.

#### 1.5 UNIT PRICES

- A. Unit Prices: Rock excavation for cylinder well holes is paid for under the unit price indicated in the Contract and as specified in Section 012200 "Unit Prices."

#### 1.6 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.
- C. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

#### 1.7 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
  1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
  1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.

2. Include large-scale layout of car-control station[ **and standby power operation control panel**].
3. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; **3-inch-** (75-mm-) square Samples of sheet materials; and **4-inch** (100-mm) lengths of running trim members.

## 1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service[ **including standby power generator**], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

## 1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.

D. Signage

- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
  - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

#### 1.11 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
  - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.13 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.14 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Minimum 12 months<Insert number> year(s) from date of Substantial Completion.

1.15 CONSTRUCTION WASTE MANAGEMENT

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

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

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

1. ThyssenKrupp
2. Dover Elevator Co.
3. KONE Inc.
4. Otis Elevator Co.
5. Schindler Elevator Corp.
6. U.S. Elevator
7. <Insert manufacturer's name>.
8. or approved equal.

B. Source Limitations: Obtain elevators[, **including electric traction passenger elevators specified in Section 142100 "Electric Traction Elevators,"**] from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** **<Insert requirement>** and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[ **and the system will be fully operational after the seismic event**]."
2. Affected peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk Zones 0 and 1)**] [**greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)**] [**greater than or equal to 0.20 (seismic risk Zones 3 and 4)**].
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

## 2.3 MATERIALS AND COMPONENTS, GENERAL

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as

included in standard preengineered elevator systems and as required for a complete system.

- B. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- D. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with DIVISION 5 for materials and fabrication.
- E. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- F. Car Frame and Platform: Welded steel units.

## 2.4 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
  - 1. Group Number: **<Insert a different number for each group of elevators that share a group operation system>**.
  - 2. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  - 3. Emergency Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  - 4. Service Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  - 5. Type: Under-the-car single cylinder.
  - 6. Type: Holeless, beside-the-car, single-acting, [**single**] [**dual**] cylinder.
  - 7. Type: Holeless, beside-the-car, telescoping, [**single**] [**dual**] cylinder.
  - 8. Type: Holeless, beside-the-car, roped hydraulic, [**single**] [**dual**] cylinder.
  - 9. Rated Load: [**2000 lb (908 kg)**] [**2100 lb (953 kg)**] [**2500 lb (1135 kg)**] [**3000 lb (1362 kg)**] [**3500 lb (1589 kg)**] [**4000 lb (1816 kg)**] [**4500 lb (2043 kg)**] [**5000 lb (2270 kg)**] **<Insert value>**.
  - 10. Freight Loading Class for Service Elevators: Class A.
  - 11. Rated Speed: [**75 or 80 fpm (0.38 or 0.41 m/s)**] [**100 fpm (0.51 m/s)**] [**125 fpm (0.64 m/s)**] [**150 fpm (0.76 m/s)**] [**175 fpm (0.89 m/s)**] [**200 fpm (1.0 m/s)**] **<Insert value>**.
  - 12. Operation System: [**Single automatic**] [**Selective-collective automatic**] [**Group automatic**].
  - 13. Auxiliary Operations:
    - a. Standby power operation.

- b. Standby-powered lowering.
  - c. Battery-powered lowering.
  - d. Automatic dispatching of loaded car.
  - e. Nuisance call cancel.
  - f. **[Emergency hospital] [Priority] service at [all] <Insert floor designations> floors.**
  - g. Independent service for **[service elevator] [one car in group] [all cars in group]**.
  - h. Loaded-car bypass.
14. Security Features: **[Card-reader operation] [Keyswitch operation] [Keypad operation] [Car-to-lobby feature]**.
15. Dual Car-Control Stations: Provide two car-control stations**[ in each elevator]**; equip only one with required keyswitches, if any.
16. Car Enclosures:
- a. Inside Width: **[64 inches (1626 mm)] [68 inches (1727 mm)] [80 inches (2032 mm)] [92 inches (2337 mm)] <Insert dimension>** from side wall to side wall.
  - b. Inside Depth: **[51 inches (1295 mm)] [53 inches (1346 mm)] [57 inches (1448 mm)] [65 inches (1651 mm)] [87-1/2 inches (2222 mm)] [90 inches (2286 mm)] [93 inches (2362 mm)] [93-1/2 inches (2375 mm)] [96 inches (2438 mm)] [101 inches (2565 mm)] [102 inches (2591 mm)] <Insert dimension>** from back wall to front wall (return panels).
  - c. Inside Height: **[88 inches (2235 mm)] [92 inches (2337 mm)] [94 inches (2388 mm)] [100 inches (2540 mm)] [104 inches (2642 mm)] [108 inches (2743 mm)] [112 inches (2845 mm)] <Insert dimension>** to underside of ceiling.
  - d. Front Walls (Return Panels): **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]** with integral car doorframes.
  - e. Car Fixtures: **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
  - f. Side and Rear Wall Panels: **[Enameled steel] [Plastic laminate] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Satin bronze, lacquered]**.
  - g. Reveals: **[Enameled steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
  - h. Door Faces (Interior): **[Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
  - i. Doorsills: **[Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
  - j. Ceiling: **[Luminous ceiling] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Reflective metallic-finish, plastic-laminate, stainless steel] [Reflective metallic-finish, plastic-laminate, bronze]**.
  - k. Handrails: **[1-1/2 inches (38 mm) round] [1/2 by 2 inches (13 by 50 mm) rectangular] <Insert dimension(s)> [mirror-polished stainless steel,**

- No. 8 finish] [satin stainless steel, No. 4 finish] [mirror-polished bronze, lacquered] [satin bronze, lacquered], at [sides] [and] [rear] of car.**
- l. Floor: Manufacturer's standard carpet.
  - m. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").
  - n. Floor prepared to receive resilient flooring (specified in Section 096500 "Resilient Flooring").
  - o. Floor recessed and prepared to receive **[dimension stone tile (specified in Section 093033 "Stone Tiling")] [ceramic tile (specified in Section 093000 "Tiling")]**.
  - p. Floor Thickness, Including Setting Materials: **<Insert thickness>** above plywood subfloor.
17. Hoistway Entrances:
- a. Width: **[36 inches (914 mm)] [42 inches (1067 mm)] [48 inches (1219 mm)] [54 inches (1372 mm)] <Insert dimension>**.
  - b. Height: **[84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>**.
  - c. Type: **[Single-speed side sliding] [Two-speed side sliding] [Single-speed center opening] [Two-speed center opening]**.
  - d. Frames **[at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
  - e. Frames at Other Floors: **[Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
  - f. Doors **[ and Transoms] [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
  - g. Doors **[ and Transoms] at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
  - h. Sills **[at First Floor] [at Basement Floors]: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
  - i. Sills at Other Floors: **[Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
18. Hall Fixtures **[at First Floor] [at Basement Floors]: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces]**.
19. Hall Fixtures at Other Floors: **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces]**.
20. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from **[polished stainless steel, No. 8 finish] [satin stainless**



**steel, No. 4 finish] [polished bronze, lacquered] [satin bronze, lacquered].**

- b. Provide hooks for protective pads[ **in all cars**] and [**one**] [**two**] <Insert number> complete set(s) of full-height protective pads.

## 2.5 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
1. Pump shall be [**submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts**] [**or**] [**shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch-(25-mm-) thick, glass-fiber insulation board**].
  2. Motor shall have [**wye-delta**] [**or**] [**solid-state**] starting.
  3. Motor shall have variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
1. Cylinder units shall be connected with dielectric couplings.
  2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Elevator manufacturer's standard [**fire-resistant**] fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
- E. Hydraulic Fluid: Nontoxic, biodegradable[, **fire-resistant**] fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.
1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch** (25-mm) clearance

from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

- H. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below **60 deg F** (16 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
    - b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
    - c. **<Insert manufacturer's name; product name or designation>**.
    - d. or approved equal.
  - I. Car Frame and Platform: Welded[ **or bolted**] steel units.
  - J. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

## 2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
  2. Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
  3. Single-Car Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
  4. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

5. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
6. Group Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
7. Group Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at **[main lobby] [fire command station] <Insert location>**.
8. Group Standby-Powered Lowering: On activation of standby power, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down.
9. Group Standby-Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.
10. Group Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
11. Group Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
12. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
13. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls **[ and predetermined weight]** can be adjusted.
14. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
15. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
16. **[Emergency Hospital] [Priority]** Service: Service is initiated by a **[keyswitch] [card reader] [remote switch]** at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks **[ and a lighted sign directs passengers to exit elevator]**. Car is placed in operation by selecting a

floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

17. Earthquake emergency operation.
18. Fire recall position

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at [**car-control stations**] [**and**] [**hall push-button stations**] to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car.
  - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
  - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable only in deactivated position.
4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamplights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection.

On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
  - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.8 CAR ENCLOSURES

- A. General: Provide **[enameled-steel car enclosures to receive removable] [steel-framed car enclosures with nonremovable]** wall panels, with **[removable]** car roof, access doors, power door operators, and ventilation.
  1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
  2. See "Allowances" Paragraph in "Summary" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car **[including materials and finishes specified below]**.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
  1. Subfloor: Exterior, underlayment grade plywood, not less than **5/8-inch** (15.9-mm) nominal thickness.
  2. Subfloor: Exterior, C-C Plugged grade plywood, not less than **7/8-inch** (22.2-mm) nominal thickness.

3. Floor Finish: [**Specified in <Insert Section number>-<Insert Section title>**] [**Elevator manufacturer's standard level-loop nylon carpet; color as selected by DEN Project Manager from manufacturer's full range**].
4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
7. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to [**1/2-inch (13-mm) fire-retardant-treated particleboard**] [**manufacturer's standard honeycomb core**] with [**plastic-laminate panel backing and**] manufacturer's standard protective edge trim. Panels have a flame-spread index of [**25**] [**75**] or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
8. Fabricate car with recesses and cutouts for signal equipment.
9. Fabricate car doorframe integrally with front wall of car.
10. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
11. Primed-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
12. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated [**from stainless-steel sheet**] [**or**] [**by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning**].
13. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
14. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim [**matching return panels**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
15. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
16. Sight Guards: Provide sight guards on car doors.
17. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
18. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
19. [**Metal**] [**Metallic-Finish, Plastic-Laminate**] Ceiling: Flush panels, with [**incandescent downlights in the center of**] [**four low-voltage downlights in**] each panel. [**Align ceiling panel joints with joints between wall panels.**]
20. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

## 2.9 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to **[NFPA 252]** **[or]** **[UL 10B]**.
- Fire-Protection Rating: **[1 hour]** **[1-1/2 hours]** **<Insert rating>** **[ with 30-minute temperature rise of 450 deg F (250 deg C)]**.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
- Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
  - Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
  - Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
  - Stainless-Steel Frames: Formed from stainless-steel sheet.
  - Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
  - Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than **3 inches** (76 mm) high, on both inside surfaces of hoistway doorframes.
  - Enameled-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
  - Primed-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
  - Stainless-Steel Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet]** **[or]** **[by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning]**.
  - Bronze Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
  - Plastic-Laminate Doors **[ and Transoms]**: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled

- cold-rolled steel doors and covering edges with protective edge trim[ **matching doorframes**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
12. Unfinished-Steel Doors[ **and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
  13. Sight Guards: Provide sight guards on doors matching door edges.
  14. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
  15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

## 2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- B. Car-Control Stations: Provide manufacturer's standard [**recessed**] [**or**] [**semirecessed**] car-control stations. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount in return panel adjacent to car door unless otherwise indicated.
  1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Swing-Return Car-Control Stations: Provide car control station fully recessed in hinged return panel adjacent to door of each car. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mark other buttons and switches with manufacturer's standard identification for required use or function.
  1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
  3. Mount controls as shown or scheduled and at heights complying with ANSI A117.1.
  4. Mount controls as shown or scheduled and at heights complying with ADA Accessibility Guidelines.
  5. Provide 2 car control stations in each passenger elevator; equip only 1 with required keyswitches, if any.
- D. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will



provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- E. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- F. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- G. Car Position Indicator: Provide [**illuminated,**] digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- H. Hall Push-Button Stations: [**Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group**] [**Provide hall push-button station at each landing as indicated**]. For each group of passenger elevators, locate between 2 elevators at center of group or at location most convenient for approaching passengers.
  - 1. Provide [**units with flat faceplate for mounting with body of unit recessed in wall**].
  - 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
  - 3. Provide 2-button stations at intermediate landings. Provide 1-button stations with direction indication at terminal landings.
  - 4. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.
- I. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Match materials, finishes, and mounting method of hall push-button stations. Provide[ **one of**] the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
  - 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
  - 3. Units mounted in both jambs of entrance frame[ **for each elevator**].

4. Units mounted in both car door jambs[; **may be used only for single elevators or for two-car groups**].
  - J. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
    1. At manufacturer's option, audible signals may be placed on cars.
  - K. Hall Position Indicators: Provide [**illuminated**, ]digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall. Match materials, finishes, and mounting method of hall push-button stations.
    1. Integrate ground-floor hall lanterns with hall position indicators.
  - L. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.[ **For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.**]
  - M. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
  - N. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.
- 2.11 FINISH MATERIALS
- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
  - B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
  - C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
  - D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
  - E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.

1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.
  2. Metal surface is [satin polished] [satin relieved] [titanium nitride colored] [oxide colored] [satin polished and titanium nitride colored] [satin relieved and titanium nitride colored] [satin polished and oxide colored] [satin relieved and oxide colored] [color coated and satin relieved] [color coated and bright relieved] after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
- I. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- J. Bronze Tubing: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- K. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), Alloy 6063.
- L. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- M. Plastic Laminate: High-pressure type complying with NEMA LD 3, [Type HGS for flat applications] [Type HGL for flat applications] [Type HGP for postformed applications] [and] [Type BKV for panel backing].

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Excavation for Cylinder: Drill well hole in [each] elevator pit to accommodate installation of cylinder; comply with applicable requirements in Section 312000 "Earth Moving."
- B. Provide [waterproof] well casing [as necessary] to retain well-hole walls.

- C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole[ **and provide permanent waterproof seal at bottom of well casing**].
1. Fill void space between protective casing and cylinder with corrosion-protective filler.
  2. Align cylinders and fill space around protective casing with fine sand.
- D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between **[well] [protective]** casing and pit floor with **4 inches** (100 mm) of nonshrink, nonmetallic grout.
- E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- G. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- H. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- I. Install piping above the floor, where possible. Install underground piping in casing.
- J. Lubricate operating parts of systems as recommended by manufacturers.
- K. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- L. Leveling Tolerance: **1/4 inch** (6 mm), up or down, regardless of load and travel direction.
- M. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- N. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
  2. Place hall lanterns either above or beside each hoistway entrance.
  3. Mount hall lanterns at a minimum of **72 inches** (1829 mm) above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load **[elevator] [each elevator] [one elevator of each type, capacity, speed, and travel distance]** to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: **[Limit temporary use for construction purposes to one elevator. ]** Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for **[each]** elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide strippable protective film on entrance and car doors and frames.
  - 3. Provide padded wood bumpers on entrance doorframes covering jambs and frame faces.
  - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
    - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
  - 5. Do not load elevators beyond their rated weight capacity.
  - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
  - 1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
  - 2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[ **each**] elevator with Owner's personnel present before date of Substantial Completion[ **and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

### 3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<**Insert number**> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance during normal working hours.
  - 2. Perform emergency callback service during normal working hours with response time of [**two**] <**Insert number**> hours or less.
  - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [**two**] <**Insert number**> hours or less.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

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

END OF SECTION 142400

## SECTION 142413 - HYDRAULIC FREIGHT ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes hydraulic freight elevators.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry.
  - 3. Section 051200 "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills[ **and entrance frames**] that are part of steel frame.
  - 4. Section 055000 "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for [**subsills**] [**and**] [**entrance frames**].
    - e. Pit ladders.
    - f. Cants in hoistways made from steel sheet.
  - 5. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
  - 6. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
  - 7. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
  - 8. Section 102213 "Wire Mesh Partitions" for guards between adjacent elevator pits.



9. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
  10. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation[ **and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.
  11. Section 31200 "Earth Moving" for excavating well hole to accommodate cylinder assembly.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.
- D. Unit Prices: Rock excavation for cylinder well holes is paid for under the unit price indicated in the Contract and as specified in Section 012200 "Unit Prices."
- ### 1.3 REFERENCES
- A. American National Standards Institute (ANSI):
1. A117.1 - Accessible and Usable Buildings and Facilities.
- B. American Society for Testing and Materials (ASTM):
1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
  3. A786A/786M - Rolled Steel Floor Plates.
  4. A793 - Rolled Floor Plate, Stainless Steel.
  5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
  6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
  7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
  8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
  9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
  10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
- C. American Society of Mechanical Engineers (ASME):
1. A17.1 - Safety Code for Elevators and Escalators.
- D. National Electrical Manufacturers Association (NEMA):
1. LD3 - High Pressure Decorative Laminates.
- E. U.S. Architectural & Transportation Barriers Compliance Board:
1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

#### 1.4 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service[ **including standby power generator**], as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
  - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
  - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.11 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work relating to hydraulic freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

## 1.12 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Minimum 12<Insert number> year(s) from date of Substantial Completion.

## 1.13 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. KONE Inc.
2. Otis Elevator Co.
3. Schindler Elevator Corp.
4. Schindler Elevator Corp.
5. U.S. Elevator.
6. **<Insert manufacturer's name>**.
7. or approved equal.

- B. Source Limitations: Obtain freight elevators[, **including electric traction freight elevators specified in Section 142100 "Electric Traction Elevators,"**] from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>** and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[ **and the system will be fully operational after the seismic event.**]"
  2. Affected peak velocity acceleration (Av) for Project's location is **[less than 0.10 (seismic risk Zones 0 and 1)] [greater than or equal to 0.10, but less than**

**0.20 (seismic risk Zone 2)] [greater than or equal to 0.20 (seismic risk Zones 3 and 4)].**

3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

## 2.3 MATERIALS AND COMPONENTS, GENERAL

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.
- B. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- D. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with DIVISION 05 for materials and fabrication.
- E. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- F. Car Frame and Platform: Welded steel units.

## 2.4 FREIGHT ELEVATORS

- A. Elevator System, General: Manufacturer's standard hydraulic freight elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
  1. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
  2. Type: Under-the-car **[single] [or] [dual]** cylinder.
  3. Type: Holeless, beside-the-car, single-acting, **[single] [dual]** cylinder.
  4. Type: Holeless, beside-the-car, telescoping, **[single] [dual]** cylinder.
  5. Type: Holeless, beside-the-car, roped hydraulic, **[single] [dual]** cylinder.
  6. Rated Load: **[2000 lb (908 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [4000 lb (1816 kg)] [5000 lb (2270 kg)] [6000 lb (2720 kg)] [8000 lb (3632 kg)] [10,000 lb (4540 kg)]**  
**<Insert value>**.
  7. Freight Loading Class: **[Class A] [Class B] [Class C1] [Class C2] [Class C3]**.

8. Rated Speed (Up): [50 fpm (0.25 m/s)] [75 or 80 fpm (0.38 or 0.41 m/s)] [100 fpm (0.51 m/s)] <Insert value>.
9. Operational Speed (Down): [Approximately 30 percent more than] [Same as] rated speed (up).
10. Operation System: [Single automatic] [Car-switch automatic floor stop] [Selective-collective automatic].
11. Auxiliary Operations:
  - a. Battery-powered lowering.
  - b. Standby power operation.
  - c. Load-weighing device.
12. Security Features: [Card-reader] [Keyswitch] operation.
13. Auxiliary Car-Control Station: Provide additional car-control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
14. Car Enclosures:
  - a. Platform Width: [60 inches (1524 mm)] [64 inches (1626 mm)] [66 inches (1676 mm)] [76 inches (1930 mm)] [78 inches (1981 mm)] [88 inches (2235 mm)] [100 inches (2540 mm)] [102 inches (2591 mm)] [124 inches (3150 mm)] [126 inches (3200 mm)] <Insert dimension>.
  - b. Platform Depth: [72 inches (1829 mm)] [84 inches (2134 mm)] [96 inches (2438 mm)] [120 inches (3048 mm)] [144 inches (3658 mm)] [168 inches (4267 mm)] <Insert dimension>.
  - c. Ceiling Height: [84 inches (2134 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)] <Insert dimension>.
  - d. Walls and Ceiling: [Prime-painted steel] [Prime-painted, metallic-coated steel] [Satin stainless steel, No. 4 finish] [Textured stainless steel].
  - e. Car Fixtures: Satin stainless steel, No. 4 finish.
  - f. Floor: [Rolled steel floor plate] [Aluminum-alloy rolled tread plate] [Rolled stainless-steel floor plate] <Insert material>.
  - g. Car Gate Type: [Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift].
  - h. Car Gate Operation: [Manual] [Power operated].
  - i. Car Gate Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
  - j. Car Sill: Steel angle.
  - k. Lighting: [One] [Two] [Three] 48-inch (1219-mm), [suspended,] [surface-mounted,] two-tube fluorescent light fixture(s) with [white reflectors] [and] [wire lamp guards].
  - l. Lighting: [One] [Two] 48-inch (1219-mm), recessed, [two] [three]-tube fluorescent light fixture(s) with UV-stabilized acrylic diffusers not less than 0.125 inch (3.2 mm) thick.
15. Hoistway Entrances:
  - a. Width: [56 inches (1422 mm)] [60 inches (1524 mm)] [62 inches (1575 mm)] [72 inches (1829 mm)] [96 inches (2438 mm)] [98 inches (2489 mm)] [120 inches (3048 mm)] [122 inches (3099 mm)] <Insert dimension>.

- b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>.
  - c. Door Type: [Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift].
  - d. Fire-Protection Rating: [1 hour] [1-1/2 hours] <Insert rating>[ with 30-minute temperature rise of 450 deg F (250 deg C)].
  - e. Door Operation: [Manual] [Power operated].
  - f. Door Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
  - g. Doorframe Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
  - h. Door[ frames and] sills are specified in [Section 051200 "Structural Steel Framing"] [Section 05500 "Metal Fabrications."]
16. Hall Fixtures: Satin stainless steel, No. 4 finish.
17. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations[ **where indicated**] mounted at height to facilitate operation by forklift-truck operator without leaving truck.
18. Additional Requirements:
- a. Door reopening device.

## 2.5 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
- 1. Pump shall be [submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts] [or] [tank-top-mounted type with fan-cooled, squirrel-cage induction motor and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board].
  - 2. Motor shall have [wye-delta] [or] [solid-state] starting.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
- 1. Cylinder units shall be connected with dielectric couplings.
  - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Elevator manufacturer's standard [**fire-resistant**] fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.



- E. Hydraulic Fluid: Nontoxic, biodegradable[, **fire-resistant**] fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.
1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch** (25-mm) clearance from cylinder and extending above pit floor. Casing shall have method of monitoring effectiveness of complying with ASME A17.1/CSA B44.
- H. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below **60 deg F** (16 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
    - b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
    - c. **<Insert manufacturer's name; product name or designation>**.
    - d. or approved equal.
- I. Car Frame and Platform: Welded[ **or bolted**] steel units.
1. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.
- J. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

## 2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
- C. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power by a switch in control panel located at [**main lobby**] [**fire command station**] **<Insert location>**.

- D. Group Standby Power Operation: On activation of standby power, cars are returned one car at a time to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch in control panel located at **[main lobby] [fire command station]** **<Insert location>**.
- E. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal light is lit in the car-control station; when car load exceeds rated capacity, car does not respond to car or hall calls.
- F. Earthquake emergency operation.
- G. Fire recall position.
- H. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Card-Reader Operation: System uses card readers at **[car-control stations]** **[and] [hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. **[Allow space as indicated for card reader in car] [Provide stripe-swipe card reader integral with each car-control station]**.
    - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
    - b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**
  2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
    - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
  3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at **[car-control stations]** **[and] [hall push-button stations]**. Key is removable **[only in deactivated position]** **[in either position]**.
  4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a

- "Restricted Floor" lamp lights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
  6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.
  7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
    - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
  8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

## 2.8 CAR ENCLOSURES

- A. General: Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.
  1. Provide power door operators with linkages for hoistway door operation.
  2. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than **0.067 inch** (1.7 mm) and reinforced at **16-inch** (406-mm) maximum spacing.
  1. Provide perforated panels for ceiling and for walls above **72 inches** (1829 mm) from car floor unless required to be solid by ASME A17.1/CSA B44.

## 2.9 HOISTWAY ENTRANCES

- A. General: Structural-steel frames and sills for hoistway entrances are specified in **[Section 051200 "Structural Steel Framing"] [Section 05500 "Metal Fabrications."]**
- B. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.
  - 1. Equip for power operation by coordinated linkage with power-operated car door.
  - 2. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.
- C. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as-close-to-neutral pressure as possible according to **[NFPA 252] [or] [UL 10B]**.
- D. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
  - 1. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than **24 inches** (610 mm) o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than **0.097 inch** (2.5 mm) thick.

## 2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.
- B. Car-Control Stations: Provide manufacturer's standard car-control station. Mount adjacent to car door unless otherwise indicated. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes.
  - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
  - 3. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will

provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- D. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- E. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- F. Car Position Indicator: Provide illuminated digital-type car position indicator, located above car door or above car-control station.
- G. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
  - 1. Provide single-button stations with [**position**] [**"in-use"**] indicator.
- H. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

## 2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, commercial steel, with **G60** (Z180) zinc coating (galvanized) or **A60** (ZF180) zinc-iron-alloy coating (galvannealed).
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- F. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
  - 1. Product: Subject to compliance with requirements, provide "<**Insert product name**>" by <**Insert manufacturer's name**>.

- G. Stainless-Steel Bars: ASTM A 276, Type 304.
- H. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- I. Rolled Steel Floor Plate: ASTM A 786/A 786M.
- J. Rolled Stainless-Steel Floor Plate: ASTM A 793.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Pattern 1, Alloy 6061-T6.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Excavation for Cylinder: Drill well hole in[ **each**] elevator pit to accommodate installation of cylinder; comply with applicable requirements in Section 312000 "Earth Moving."
- B. If retaining first paragraph below, usually delete "waterproof" option and retain "as necessary" option. Well casing is essentially part of Contractor's means and methods unless required by authorities having jurisdiction; however, requiring a well casing helps prevent disputes if cylinder well-hole excavation is not being provided by elevator Installer.
- C. Provide[ **waterproof**] well casing[ **as necessary**] to retain well-hole walls.
- D. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole[ **and provide permanent waterproof seal at bottom of well casing**].
  - 1. Fill void space between protective casing and cylinder with corrosion-protective filler.
  - 2. Align cylinders and fill space around protective casing with fine sand.

- E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between **[well] [protective]** casing and pit floor with **4 inches** (100 mm) of nonshrink, nonmetallic grout.
- F. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- G. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualifications standards.
- H. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- I. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- J. Install piping above the floor, where possible. Install underground piping in casing.
- K. Lubricate operating parts of systems as recommended by manufacturers.
- L. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load **[elevator] [each elevator] [one elevator of each type, capacity, speed, and travel distance]** to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for[ **each**] elevator used for construction purposes:
1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
    - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
  2. Do not load elevators beyond their rated weight capacity.
  3. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
  2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[ **each**] elevator with Owner's personnel present and before date of Substantial Completion[ **and not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.



### 3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
1. Perform maintenance during normal working hours.
  2. Perform emergency callback service during normal working hours with response time of [two] <Insert number> hours or less.
  3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [two] <Insert number> hours or less.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 142413

## SECTION 143100 - ESCALATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes [**standard**] [**and**] [**high-traffic,**] [**interior**] [**and**] [**exterior**] escalators.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 051200 "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support escalator trusses.
  - 3. Section 083113 "Access Doors and Frames" for wall and ceiling access panels and access doors in escalator enclosures.
  - 4. Section 101400 "Signage" for "Caution" signs required by ASME A17.1/CSA B44.
  - 5. [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for smoke detectors that activate escalator alarm and, after at least 15 seconds, cause the interruption of power to the escalator motor and brake and for connection to escalator controllers.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 DEFINITIONS

- A. High-Traffic Escalators: Designed specifically for high-traffic-volume use that produces dense occupancy resulting in structural, machinery, and brake loads much higher than normal.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
  - 1. Include data substantiating that materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction.
2. Indicate maximum loads imposed on building structure at points of support, and power requirements.
3. Indicate access and ventilation for escalator machine space.

C. Samples for Initial Selection: For exposed materials involving color selection.

D. Samples for Verification: For exposed escalator finishes, **3-inch-** (75-mm-) square Samples of sheet materials, and **4-inch** (100-mm) lengths of running trim members.

E. Delegated-Design Submittal: For escalators.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For escalator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert

**agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

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

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Escalator manufacturer[ **or an authorized representative who is trained and approved by manufacturer**].

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.9 COORDINATION

- A. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits; electrical service; and electrical outlets, lights, and switches in pits.

## 1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace escalator work that fails in materials or workmanship within specified warranty period.
- Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - Warranty Period: Minimum **<Insert number>** year(s) from date of Substantial Completion.

## 1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fujitec America, Inc.
  2. KONE Inc.
  3. Mitsubishi Electric Corporation.
  4. Otis Elevator Co.
  5. Schindler Elevator Corp.
  6. ThyssenKrupp Elevator.
  7. **<Insert manufacturer's name>**.
  8. or approved equal.
- B. Source Limitations: Obtain escalators[ **and moving walks, specified in another Section,**] from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than **3 ft./s<sup>2</sup>** (0.91 m/s<sup>2</sup>).
- C. Braking Performance: Provide brakes that produce a stopping force on escalator in up-running mode that is one-third that used in down-running mode.
- D. Step/Skirt Performance Index: Not more than 0.15.
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design escalators.
- F. Seismic Performance: Escalators shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] **<Insert requirement>**.
1. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
  2. Project's Seismic Design Category: [**A**] [**B**] [**C**] [**D**] [**E**] [**F**].
  3. Escalator Component Importance Factor: 1.0.
- G. Structural and Mechanical Performance for High-Traffic Escalators: For the purposes of structural design, driving machine and power transmission calculations, and brake

calculations, design high-traffic escalators for loads not less than **[two]** <Insert **number**> times the design loads required by ASME A17.1/CSA B44.

- H. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE/SEI 7 for handrail assemblies and guardrail systems.

## 2.3 ESCALATORS

- A. Escalators, General: Manufacturer's standard escalators complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard escalator systems and as required for complete system.
- B. High-Traffic Escalators, General: Manufacturer's high-traffic escalators complying with requirements. Unless otherwise indicated, manufacturer's heavy-duty components shall be used, as included in standard high-traffic escalator systems and as required for complete system.
- C. Design and equip escalators to run in either direction.
- D. Provide escalators with **[two]** **[three]** **[four]** flat steps at top and bottom landings.
- E. Rated Speed: **[90 fpm (0.46 m/s)]** **[or]** **[100 fpm (0.5 m/s)]**.

## 2.4 COMPONENTS

- A. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- B. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. **[ Prepared for exterior finish below the deck covers; exterior finish specified in another Section.]**
- C. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories. **[ Prepared for exterior finish below the deck covers; exterior finish specified in another Section.]**
- D. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches** (50 mm) in diameter in **[right-hand]** **[both]** balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.
- E. Guards at Ceiling Intersection: Clear plastic.

- F. Handrails: Smooth, jointless, reinforced neoprene.
1. Color: **[Black] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- G. Deck Covers and Trim: **[Satin stainless steel] [Polished stainless steel] [Gold-colored, satin stainless steel] [Gold-colored, polished stainless steel] [Satin bronze]**.
- H. Antislip Devices: **[Satin stainless steel] [Polished stainless steel] [Gold-colored, satin stainless steel] [Gold-colored, polished stainless steel] [Satin bronze]**.
- I. Balustrade Interior Panels: **[Satin stainless steel] [Polished stainless steel] [Gold-colored, satin stainless steel] [Gold-colored, polished stainless steel] [Satin bronze]**.
- J. Balustrade Exterior Panels[ and Escalator Soffits]: **[Satin stainless steel] [Polished stainless steel] [Gold-colored, satin stainless steel] [Gold-colored, polished stainless steel] [Satin bronze]**.
- K. Skirt Panels[, if Applicable]: **[Satin stainless steel] [Polished stainless steel] [Satin stainless steel with exposed surface coated with clear PTFE] [Steel panels with exposed surface coated with PTFE] [Manufacturer's standard low-friction material]**.
- L. Skirt Deflector Devices: Manufacturer's standard brush-type device.
- M. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.
1. Finish: Powder-coated, **[gray] [black] <Insert color>**.
  2. Step Demarcation: **1-1/2- to 2-inch-** (38- to 50-mm-) wide yellow stripe at sides and backs of step treads.
  3. Nosing Demarcation: **2-inch-** (50-mm-) wide yellow stripe at nosings of step treads.
- N. Combs: **[Integrally colored structural plastic] [Cast aluminum] [Cast aluminum with powder-coated finish]**.
1. Comb Color: **[Yellow] [Black] [Gray] [Red] <Insert color>**.
- O. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates, designed to illuminate combplate steps.
- P. Floor Plates: **[Cast or extruded aluminum] [Stainless steel]** with grooved or patterned surface[ and with abrasive material embedded in or metallically bonded to floor-plate surface].

## 2.5 FEATURES

- A. Operational Control: Provide key-operated starter switches[ **and key-operated switches for directional control**] located on exterior deck above newel base at both upper and lower landings of escalators.
- B. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory the date, time, and device identification if a safety device is activated or escalator malfunctions.
  - 1. Provide built-in[ **or plug-in**] unit to display recorded information.
- C. Reduced-Current Starting: Provide escalator motors with wye-delta or solid-state starting.
- D. Energy-Saving Feature: Provide escalator motors and controls designed for motors running on partial windings (at reduced power) when not under full load.
- E. Provide motors complying with NEMA MG 1, Insulation Class B.
- F. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
- G. Equip step drive mechanism with automatic step-chain lubricators.
- H. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf** (1.1 kN) on a **1.0-sq. ft.** (0.9-sq. m) area at any location without permanent deflection.
- I. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.
- J. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.
- K. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **400 lbf** (1780 N) at either side or exceeding **800 lbf** (3560 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.
- L. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf** (500 N) at either side or exceeding **225 lbf** (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.



## 2.6 EXTERIOR ESCALATORS

- A. Fabricate exposed components from [**stainless steel**] [**bronze**] unless otherwise indicated.
- B. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners.
- C. Fabricate oil drip pan from galvanized-steel sheet. Provide drain and oil/water separator in oil drip pan.
- D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
- E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
- F. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.
- G. Equip step drive mechanism with automatic step-chain lubricators.
- H. Provide electric heaters with integral thermostats in escalator truss space to maintain temperature above 40 deg F (4.4 deg C).
- I. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

## 2.7 MATERIALS

- A. Stainless Steel: ASTM A 240/A 240M, [**Type 304**] [**Type 316**] [**Type 304, except use Type 316 for exterior escalators**].
  - 1. Satin Finish: No. 4 directional satin.
  - 2. Polished Finish: No. 8 mirror polish.
  - 3. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
  - 4. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
- B. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
- C. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
- D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- E. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.

- F. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), [10.0] [12.0] mm thick.
1. Color: [**Bronze**] [**Gray**] [**Green**] <Insert color>.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine escalator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. [**Install oil drip pans and verify that no oil drips outside of pans.**]
- D. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

#### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of escalator installation and before permitting escalator use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.
  1. For escalators specified to comply with requirements more stringent than those of ASME A17.1/CSA B44, perform tests for compliance with specified

requirements. Test safety devices that are not required by ASME A17.1/CSA B44 as well as those that are.

- B. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] escalators.
  - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of escalators with Owner's personnel present before date of Substantial Completion[ **and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

### 3.5 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<Insert number> months' full maintenance by skilled employees of escalator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper escalator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance during normal working hours.
  - 2. Perform emergency callback service during normal working hours with response time of [two] <Insert number> hours or less.
  - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [two] <Insert number> hours or less.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 143100

## SECTION 143200 - MOVING WALKS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes [**interior**] [**and**] [**exterior**] moving walks.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 051200 "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support moving walk trusses.
  - 3. Section 083113 "Access Doors and Frames" for wall and ceiling access panels and access doors in moving walk enclosures.
  - 4. Section 101400 "Signage" for "Caution" signs required by ASME A17.1/CSA B44.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction.
  - 2. Indicate maximum loads imposed on building structure at points of support, and power requirements.
  - 3. Indicate access and ventilation for moving walk machine space.
- C. Samples for Verification: For exposed finishes, **3-inch**- (75-mm-) square Samples of sheet materials and **4-inch** (100-mm) lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by manufacturer certifying that moving walk layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for moving walks being provided.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For moving walks to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of moving walks.
- C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- D. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Moving walk manufacturer[ **or an authorized representative who is trained and approved by manufacturer**].

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of sleeves, block outs, moving walk equipment with integral anchors, and other items that are embedded in concrete or masonry for moving walk

equipment. Furnish templates, sleeves, moving walk equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

- B. Coordinate locations and dimensions of other work relating to moving walks including sumps and floor drains in pits; electrical service; and electrical outlets, lights, and switches in pits.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace moving walk work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Minimum **<Insert number>** year(s) from date of Substantial Completion.

## 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fujitec America, Inc.
  - 2. KONE Inc.
  - 3. Mitsubishi Electric Corporation.
  - 4. Otis Elevator Co.
  - 5. Schindler Elevator Corp.
  - 6. ThyssenKrupp Elevator.
  - 7. Westmont Industries.
  - 8. **<Insert manufacturer's name>**.
  - 9. or approved equal.
- B. Source Limitations: Obtain moving walks[ **and escalators, specified in another Section,**] from a single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE/SEI 7 for handrail assemblies and guardrail systems.

## 2.3 MOVING WALKS

- A. Moving Walks, General: Manufacturer's standard [**pallet-**] [**or**] [**belt-**]type moving walks complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used as included in standard moving walk systems and as required for complete system.
- B. Design and equip moving walks to run in either direction.
- C. Rated Speed: [90 fpm (0.45 m/s)] [100 fpm (0.5 m/s)] [120 fpm (0.6 m/s)] [130 fpm (0.66 m/s)] [150 fpm (0.76 m/s)] <Insert value>.

## 2.4 COMPONENTS

- A. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- B. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories.[ **Prepared for exterior finish below the deck covers; exterior finish specified in another Section.**]
- C. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by [**clear**] [**tinted**] tempered glass panels, with deck covers, skirts, trim, and accessories.[ **Prepared for exterior finish below the deck covers; exterior finish specified in another Section.**]
- D. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches** (50 mm) in diameter in [**right-hand**] [**both**] balustrade newels at both landings. Green light indicates entrance end, and red light indicates exit end. When moving walk is stopped, red lights are illuminated at both ends.
- E. Handrails: Smooth, jointless, reinforced neoprene.
  - 1. Color: [**Black**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.



- F. Deck Covers and Trim: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- G. Balustrade Interior Panels: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- H. Balustrade Exterior Panels: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- I. Skirt Panels, if Applicable: [**Polished stainless steel**] [**Satin stainless steel with exposed surface coated with clear PTFE**] [**Steel panels with exposed surface coated with PTFE**].
1. Clearance between skirt panels or overhanging balustrade panels and treadway shall not exceed **1/16 inch** (1.6 mm).
- J. Combs: [**Integrally colored structural plastic**] [**Cast aluminum**] [**Cast aluminum with powder-coated finish**].
1. Comb Color: [**Yellow**] [**Black**] [**Gray**] [**Red**] <Insert color>.
- K. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in interior balustrade panels at each side of combplates, designed to illuminate treadway at combplate.
- L. Floor Plates: [**Cast or extruded aluminum**] [**Stainless steel**] with grooved or patterned surface[ **and with abrasive material embedded in or metallically bonded to floor-plate surface**].

## 2.5 FEATURES

- A. Operational Control: Provide key-operated starter switches[ **and key-operated switches for directional control**] located on exterior deck above newel base at both ends of moving walks.
- B. Fault Indicator: Provide moving walks with a microprocessor unit that monitors safety devices, motor temperature, and moving walk speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or moving walk malfunctions.
1. Provide built-in[ **or plug-in**] unit to display recorded information.
- C. Reduced-Current Starting: Provide moving walk motors with wye-delta or solid-state starting.
- D. Energy-Saving Feature: Provide moving walk motors and controls designed for motors running on partial windings (at reduced power) when not under full load.

- E. Brake-Saving Feature: Provide stopping mechanism that allows moving walks to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
- F. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
- G. Oil Drip Pan: Provide metal pan under full width and length of moving walks to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf** (1.1 kN) on a **1.0-sq. ft.** (0.09-sq. m) area at any location without permanent deflection.
- H. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **400 lbf** (1780 N) at either side or exceeding **800 lbf** (3560 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.
- I. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf** (500 N) at either side or exceeding **225 lbf** (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.

## 2.6 EXTERIOR MOVING WALKS

- A. Fabricate exposed components from [**stainless steel**] [**bronze**] unless otherwise indicated.
- B. Hot-dip galvanize moving walk trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for moving walk component assembly.
- C. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
- D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
- E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
- F. Provide totally enclosed fan-cooled motors complying with NEMA MG 1, Insulation Class B.
- G. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
- H. Provide electric heaters with integral thermostats in moving walk truss space to maintain temperature above **40 deg F** (4.4 deg C).
- I. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

## 2.7 MATERIALS

- A. Stainless Steel: ASTM A 240/A 240M, [**Type 304**] [**Type 316**] [**Type 304, except use Type 316 for exterior moving walks**].
1. Satin Finish: No. 4 directional satin.
  2. Polished Finish: No. 8 mirror polish.
  3. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
  4. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
- B. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
- C. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
- D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- E. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.
- F. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.
1. Color: [**Bronze**] [**Gray**] [**Green**] <Insert color>.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine moving walk areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which moving walks are to be installed.
- B. Prepare a written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.

- B. Set moving walks true to line and level[, **or to indicated slope**], properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
- D. Repair damaged finishes so no evidence remains of correction work. Return items to the shop that cannot be refinished in the field, make required repairs and refinish entire unit, or provide new units as required.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of moving walk installation and before permitting moving walk use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.
  - 1. For moving walks specified to comply with requirements more stringent than those of ASME A17.1/CSA B44, perform tests for compliance with specified requirements.
- B. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] moving walks.
  - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of moving walks with Owner's personnel present before date of Substantial Completion[ **and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

### 3.5 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<**Insert number**> months' full maintenance by skilled employees of moving walk Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper moving walk operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of **[two]** <Insert number> hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of **[two]** <Insert number> hours or less.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

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

END OF SECTION 143200

## SECTION 210400 - BASIC FIRE-SUPPRESSION REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Basic requirements common to the Work in general of Division 21 and other Divisions and Sections of the Specification where referenced.
  - 2. Provide, unless specified otherwise, all labor, materials, and equipment necessary for completely finished and operational fire protection systems described and specified under other Sections of this Division 21.
  - 3. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the Work even though not specified or indicated.
  - 4. Inspection: Inspect Work preceding or interfacing with work of Division 21 and report any known or observed defects that affect the Work to the General Contractor. Do not proceed with the Work until defects are corrected.

#### 1.3 REFERENCES

- A. General:
  - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Codes.
  - 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
  - 3. When required by individual Specifications Section by means of reference for cleaning or installation requirements, etc., obtain a copy of the standard. Maintain the copy at job site during Work until substantial completion. Copy shall be in electronic format.
  - 4. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

- a. ABMA–American Bearing Manufacturers Association
- b. ACI–American Concrete Institute
- c. ASA–American National Standards on Acoustics and Vibrations
- d. ASME–American Society of Mechanical Engineers
- e. ASTM–American Society for Testing of Materials
- f. AGA–American Gas Association
- g. ANSI–American National Standards Institute
- h. API–American Petroleum Institute
- i. ASME–American Society of Mechanical Engineers
- j. ATA–Air Transport Association of America
- k. AWS–American Welding Society
- l. EPA–Environmental Protection Agency
- m. CISPI–Cast Iron Soil Pipe Institute
- n. FM–Factory Mutual Insurance Association
- o. HI–Hydronics Institute
- p. IFC–International Fire Code
- q. MSS–Manufacturers Standardization Society of the Valve and Fittings Industry
- r. NACE–National Association of Corrosion Engineers
- s. NAPCA–National Association of Pipe Coating Applicators
- t. NFPA–National Fire Protection Association
- u. NIST–National Institute of Science and Technology
- v. ABMA–American Bearing Manufacturers Association
- w. SSPC–The Society for Protective Coatings
- x. STI–Steel Tank Institute
- y. UL–Underwriters' Laboratories

#### 1.4 DEFINITIONS

- A. Conform to Division 01: These Specifications are of abbreviated, simplified, or streamlined type and include incomplete sentences. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. The following words are re-defined and/or elaborated on for the context of Division 21 work:
  - 1. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
  - 2. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
  - 3. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
  - 4. General Contractor: The term "General Contractor" used in Division 21 and elsewhere in the Contract Documents means the party with whom the Owner has

executed the Owner-Contractor Agreement.

## 1.5 QUALITY CONTROL

- A. Conform to Division 01. Materials and apparatus required for the Work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
- B. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the Manufacturer. This includes the performance of tests as recommended by the Manufacturer.

## 1.6 REGULATORY REQUIREMENTS

- A. Comply with latest editions of all applicable Codes, Standards, Ordinances and Regulations in effect as of the date of the Contract Documents adopted by CCD, BD, and FD, including but not necessarily limited to the following:
  - 1. National Electrical Code NFPA-70.
  - 2. NFPA.
  - 3. Underwriters Laboratories.
- B. If discrepancies occur between the Contract Documents and any applicable Codes, Guidelines, Ordinances, Acts, or Standards, the most stringent requirements shall apply.
- C. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

## 1.7 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions: Refer to Division 01, General Requirements.
- B. Some materials and equipment are specified by Manufacturer and catalog numbers. The Manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. When alternate or substitute materials and equipment are used, Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use.
- D. When providing a product and/or service under the qualification of "acceptable equal,"



Contractor shall be entirely responsible for additional costs incurred due to modifications to the civil, architectural, structural, mechanical, electrical, or any other system design that may be required to accommodate the "acceptable equal."

- E. Substitute materials and equipment are only allowed to be provided from the manufacturers listed as approved.

## 1.8 SHOP DRAWINGS AND PRODUCT DATA

- A. General: Comply with the General Conditions of the Contract and with Division 01 General Requirements.

- 1. All documents shall be submitted in electronic format. Each submittal shall be in a single security free PDF document. PDF documents shall be compatible with the latest version of Adobe Acrobat. All as-built documents shall be submitted in the latest version of Revit format.

## 1.9 CONTRACT RECORD DOCUMENTS

- A. General: Comply with the General Conditions of the Contract and with Division 01 General Requirements,

## 1.10 OPERATING AND MAINTENANCE DATA

- A. Division 21 Contractor shall submit electronic record, in accordance with Division 1 requirements, a single PDF file of the entire maintenance manual to the DEN Project Manager and General Contractor for their approval.

- B. The manual shall have as a minimum the following:

- 1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
- 2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown.
- 3. Maintenance instructions, including valves, valve tag, and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
  - a. Manufacturer's data on each piece of equipment, including:
    - 1) Installation instructions.
    - 2) Drawings, specifications, and approved shop drawings.
    - 3) Complete parts lists.

4. Complete wiring and temperature control diagrams (approved shop drawings).
  5. Each piece identified on any schedule shall be bookmarked in the electronic file by its scheduled tag ID.
- C. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified elsewhere. Insert a copy.
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
  2. Tag all manual operating valves with 1-1/2" diameter brass tags attached with chains. Tags are to be sequence numbered with legible metal stamps. Obtain latest tag identification schedule from the DEN Project Manager.
  3. Provide a typed tag list or schedule mounted under glass in the room designated by DEN Project Manager stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
- D. Division 21 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all fire suppression systems, using the maintenance manual as a guide. These meetings must be scheduled through the DEN Project Manager, and General Contractor far enough in advance so that all personnel can be notified.
- E. Division 21 Contractor shall provide proof of performance certification of all fire suppression systems to demonstrate that all fire suppression systems are operating to the intent of the design.

#### 1.11 FINAL OBSERVATION

- A. Comply with the requirements of Division 01 and the following.
- B. Prior to the request for final observation, all Work under the contract shall be completed, all systems shall be in proper working order and placed in operation (System Startup of 48 hours).
- C. All equipment shall be cleaned, including but not limited to, plumbing fixtures. All debris and construction materials shall be removed from the DEN property to a suitable landfill off-airport.
- D. The temperature control system shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.
- E. At the request of the DEN Project Manager, a representative of the Contractor who is thoroughly familiar with the Project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested by the DEN Project Manager, the Contractor shall have representatives from the Contractor's subcontractors present to assist during final observation.

## 1.12 PROJECT CONDITIONS

### A. Accessibility:

1. Division 21 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of the Contractor's Work. The Contractor shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the General Contractor of the Contractor's requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 21 Contractor shall locate all equipment, which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, and drain points. If required for better accessibility, furnish access doors for this purpose, minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the DEN Project Manager prior to making the change.
3. Division 21 Contractor shall provide the General Contractor with the exact locations of access doors for each concealed valve, shock absorber control, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Provide carpentry, masonry, concrete and metal work required for Work of this Division where not specifically called for under other Sections.

### B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of existing conditions and new structural and architectural Work.

### C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

### D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

### 1.13 COORDINATION

- A. General: Coordinate and order the progress of fire protection Work to conform to the progress of the Work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Electrical Work: Section 210500 "Common Work Results for Fire Suppression".
- C. Existing System Interruptions: Comply with Division 01.
- D. Cutting and Patching: Section 210500 "Common Work Results for Fire Suppression", Division 01 requirements, and Section 017330 "Cutting and Patching".
- E. Drawings and Specifications: The Fire Protection Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown may be diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Review dimensions, measurements, locations, levels, etc., on the architectural drawings and equipment to be furnished, and field verify all dimensions.
- F. Discrepancies: Examine Drawings and Specifications for other parts of the Work, and if any discrepancies occur between the plans for the Work of this Division and the plans for the work of others, report such discrepancies to the DEN Project Manager and obtain written instructions for any changes necessary.
- G. Order of Precedence: The precedence of construction documents are as Specified in the General Conditions.

### 1.14 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition, which may cause damage to equipment or endanger personnel.
- B. Ensure that all control systems are fully operational in automatic mode.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to ensure against accidental operation or operation by unauthorized personnel.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify the DEN Project Manager in writing a minimum of 72 hours prior to start-up of all major fire protection equipment and systems.
- F. Should there be any equipment found which had not been properly started up, it will be the responsibility of this Contractor to arrange for the appropriate personnel to start up the equipment at the Contractor's expense and at a time as scheduled by the DEN

Project Manager.

#### 1.15 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 21 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. Notify the DEN Project Manager, DEN Inspector, and DEN Mechanical Engineer in writing a minimum of 72 hours prior to testing of any fire protection equipment and systems.
- D. All testing must be performed in the presence of the DEN Project Manager and or the DEN Project Manager's designated representative; DEN Project Manager's signature for verification of the test must appear on the schedule.
- E. All testing must be performed in accord with the procedures set forth in Division 21 and other Sections of the Specifications where referenced. At completion of testing, the schedule shall then be submitted in triplicate to the DEN Project Manager.
- F. Make all specified tests on piping, ductwork, and related systems as necessary.
- G. Make sure operational and performance tests are made on seasonal equipment.
- H. Complete all tests required by Code Authorities, such as health codes, building codes, and safety codes.
- I. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packing properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

#### 1.16 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Requirements of the Contract.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints, and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 21 of the Work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

#### 1.17 WARRANTIES

- A. Conform to Division 01: Provide a written warranty covering the entire fire protection

Work to be free from defective materials, equipment, and workmanship for a minimum period of two (2) years after date of acceptance. During this period, provide labor and materials as required to repair or provide labor and materials required to repair or replace defects. Provide certificates for such items of equipment, which have or are specified to have warranties in excess of one (1) year.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 210400

## SECTION 230400 - BASIC HVAC REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Basic requirements common to the work in general of Division 23 and other Divisions and Sections of the Specification where referenced.
- B. Provide, unless specified otherwise, all labor, materials, and equipment necessary for completely finished and operational HVAC systems described and specified under other Sections of this Division 23.
- C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.
- D. Inspection: Inspect work preceding or interfacing with work of Division 23 and report any known or observed defects that affect the Work to the General Contractor. Do not proceed with the work until defects are corrected.
- E. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 REFERENCES

- A. General:
  - 1. For products or workmanship specified by association, trade, or Federal Standards comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Codes.
  - 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
  - 3. When required by individual Specifications Section by means of reference for cleaning or installation requirements, etc., obtain a copy of the standard. Maintain the copy at job site during work until substantial completion. Copy may be in electronic format.
  - 4. Schedule of Referenced Organizations: Reference Section 014200 "References" for a list of the acronyms of organizations referenced in these Specifications.

#### 1.4 DEFINITIONS

- A. Conform to Division 01: These Specifications are of abbreviated, simplified, or streamlined type and include incomplete sentences. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. The following words are re-defined and/or elaborated on for the context of Division 23 work:
  - 1. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
  - 2. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
  - 3. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
  - 4. General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

#### 1.5 QUALITY CONTROL

- A. Conform to Division 01. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
- B. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the Manufacturer. This includes the performance of tests as recommended by the Manufacturer.

#### 1.6 REGULATORY REQUIREMENTS

- A. Comply with latest editions of all applicable Codes, Standards, Ordinances and Regulations in effect as of the date of the Contract Documents adopted by CCD, BD, and FD, including but not necessarily limited to the following:
  - 1. National Electrical Code NFPA-70.
  - 2. NFPA.
  - 3. ASHRAE.
  - 4. SMACNA.
  - 5. Underwriters Laboratories.



- B. If discrepancies occur between the Contract Documents and any applicable Codes, Guidelines, Ordinances, Acts, or Standards, the most stringent requirements shall apply.
- C. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

#### 1.7 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions: Refer to Division 01, General Requirements.
- B. Some materials and equipment are specified by Manufacturer and catalog numbers. The Manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. When alternate or substitute materials and equipment are used, Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use.
- D. When providing a product and/or service under the qualification of "acceptable equal," Contractor shall be entirely responsible for additional costs incurred due to modifications to the civil, architectural, structural, mechanical, and electrical design that may be required to accommodate the "acceptable equal."
- E. Substitute materials and equipment are only allowed to be provided from the Manufacturers listed as approved.

#### 1.8 SHOP DRAWINGS, PRODUCT DATA, AND AS-BUILT DRAWINGS

- A. General: Comply with the General Conditions of the Contract and with Division 01 - General Requirements.
  - 1. All documents shall be submitted in electronic format.
  - 2. All submittals to be provided in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.9 CONTRACT RECORD DOCUMENTS

- A. General: Comply with the General Conditions of the Contract and with Division 01 - General Requirements,
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.10 OPERATING AND MAINTENANCE DATA

- A. HVAC Contractor shall submit electronic copy containing a single PDF file of the entire maintenance manual to the DEN Project Manager, General Contractor for their approval.
- B. All submittals to be provided in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- C. The manual shall have:
1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
  2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown.
  3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
  4. Manufacturer's data on each piece of equipment, including:
    - a. Installation instructions.
    - b. Drawings and specifications (approved shop drawings).
    - c. Parts lists.
    - d. Complete wiring and temperature control diagrams (approved shop drawings).
  5. Each piece identified on any schedule shall be bookmarked in the electronic file by its scheduled tag ID (IE: AHU-1)
- D. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified elsewhere. Insert a copy.
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
  2. Tag all manual operating valves with 1-1/2" diameter brass tags attached with chains. Tags are to be sequence numbered with legible metal stamps.
  3. Provide a typed tag list or schedule mounted under glass in the room designated by DEN Project Manager stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
- E. Division 23 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the DEN Project Manager, and General Contractor far enough in advance so that all personnel can be notified.
- F. Division 23 Contractor shall provide proof of performance certification of all Mechanical

Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design.

#### 1.11 FINAL OBSERVATION

A. Comply with the requirements of Division 01 and the following:

1. Prior to the request for final observation, all Work under the contract shall be completed; all systems shall be in proper working order and placed in operation (System Startup of 48 hours).
2. All HVAC systems shall be properly balanced with quantities shown on the Drawings, and all water circuits shall be adjusted to provide the proper flows.
3. All equipment shall be cleaned, including but not limited to, plumbing fixtures. All debris and construction materials shall be removed from the DEN property to a DEN approved landfill off-airport.
4. The temperature control system shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.
5. At the request of the DEN Project Manager, a representative of the Contractor who is thoroughly familiar with the Project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested by the DEN Project Manager, the Contractor shall have representatives from his subcontractors present to assist during final observation.

#### 1.12 PROJECT CONDITIONS

A. Accessibility.

1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 23 Contractor shall locate all equipment, which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the DEN Project Manager prior to making the change.
3. Division 23 Contractor shall provide the General Contractor with the exact locations of access doors for each concealed valve, shock absorber control, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.

B. Fabrication.

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of existing conditions and new Structural and Architectural Work.

C. Freeze Protection.

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

D. Scaffolding, Rigging and Hoisting.

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

1.13 COORDINATION

- A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Division 21 Fire Suppression, Division 22 Plumbing, Division 26 Electrical, and Division 33 Utilities and other Divisions as required to perform the Work..
- C. Existing System Interruptions: Comply with Division 01.
- D. Cutting and Patching: Section 024119 "Selective Demolition".
- E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural and Engineering Drawings and equipment to be furnished.
- F. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the DEN Project Manager and obtain written instructions for any changes necessary.
- G. Order of Precedence: The precedence of construction documents are as Specified in the General Conditions.

#### 1.14 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition, which may cause damage to equipment or endanger personnel.
- B. Ensure that all control systems are fully operational in automatic mode.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to ensure against accidental operation or operation by unauthorized personnel.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify the DEN Project Manager in writing a minimum of 48 hours prior to start-up of all major mechanical equipment and systems.
- F. Should there be any equipment found which had not been properly started up, it will be the responsibility of this Contractor to arrange for the appropriate personnel to start up the equipment at his expense and at a time as scheduled by the DEN Project Manager.

#### 1.15 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. Notify the DEN Project Manager, DEN Mechanical Inspector, and DEN Mechanical Engineer in writing a minimum of 72 hours prior to testing of any mechanical equipment and systems.
- D. All testing must be performed in the presence DEN Project Manager and or his designated representative; his signature for verification of the test must appear on the schedule.
- E. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the schedule shall then be submitted in triplicate to the DEN Project Manager.
- F. Make all specified tests on piping, ductwork, and related systems as necessary.
- G. Make sure operational and performance tests are made on seasonal equipment.
- H. Complete all tests required by Code Authorities, such as health codes, building codes, and safety codes.

- I. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packing properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

#### 1.16 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Requirements of the Contract.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints, and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.
- C. Clean HVAC Systems in accordance with applicable Division 23 Sections.

#### 1.17 WARRANTIES

- A. Conform to Division 1: Provide a written warranty covering the entire mechanical work to be free from defective materials, equipment, and workmanship for a period of two (2) years after date of acceptance. During this period, provide labor and materials as required to repair or provide labor and materials required to repair or replace defects.
- B. Provide special warranties for such items of equipment that have been or are specified to have warranties in excess of two (2) years.

### **PART 2 - PRODUCTS (Not Applicable)**

### **PART 3 - EXECUTION (Not Applicable)**

### **PART 4 - MEASUREMENT**

#### 4.1 METHOD OF MEASUREMENT

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

### **PART 5 - PAYMENT**

#### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 230400

## SECTION 260400 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Certain labor, materials, and equipment may be furnished under other Sections of these specifications, by utility Companies or by the Owner. When this is the case, the extent, source and description of these items will be as indicated on the drawings or as described in the specifications.
- B. Where a panel is installed, at least 25% of panel capacity, accounting for serving panel capacity, shall remain as spare capacity after project completion.
- C. Where existing panels are used for additional work, when six (6) or less spaces remain a new panel shall be installed.
- D. All electrical/electronic circuits, including audio, video and fire alarm systems, shall be in an approved raceway system. No "wild circuits" will be accepted.
- E. The Designer of Record shall not design or specify and the Contractor shall not install rigid metal conduit, electrical metallic tubing, flexible steel conduit, liquid-tight flexible steel conduit, non-metallic rigid conduit or innerduct in any horizontal or vertical concrete wall or slab structures or portions thereof, e.g., cast-in-place concrete floor slab on steel decking; cast-in-place concrete slabs integral with concrete structural support systems; prestressed concrete slabs; post-tensioned concrete slabs; precast concrete construction with or without field applied or plant fabricated concrete topping slabs, slabs on grade, foundation walls or in concrete cast-in-place walls, etc.
- F. Related Sections:
  - 1. Basic Electrical Requirements specifically applicable to all Division 26 Sections, in addition to Division 1 General Requirements, and Divisions 11, 14, 21, 22, 23, 27 and 28.
  - 2. All electrical/electronic circuits and equipment from any other Division shall meet the requirements of Division 26.
  - 3. Description: Work shall consist of furnishing all labor, equipment, supplies, and materials, unless otherwise specified, necessary for the installation of complete electrical systems as required by the specifications and as shown on the drawings, subject to the terms and conditions of the Contract. The Work shall also include the completion of those details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems.



4. Temporary Power: See Division 1 for construction power constraints.

G. REFERENCE STANDARDS

H. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

I. Latest editions of the following:

1. ANSI/NFPA 70 - National Electrical Code (as adopted and amended by the Denver Building Department).
2. International Fire Code (as amended by the Denver Fire Department).
3. International Building Code (as adopted and amended by the Denver Building Department).
4. International Energy Conservation Code (as adopted and amended by the Denver Building Department).
5. ANSI/IEEE C2 - National Electrical Safety Code.
6. OSHA - Occupational Safety and Health Administration, as Amended
7. Underwriter's Laboratory (UL).
8. National Fire Protection Association (NFPA).
9. Other references as listed elsewhere in these specifications.
10. IEEE Standard 519- Recommended Practices and Requirement for Harmonic Control in Electrical Power Systems.

1.3 DEFINITIONS

- A. "Furnish" or "Provide": To supply, install and connect complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
- B. "Install": To erect, mount and connect complete with related accessories.
- C. "Supply": To purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.
- E. "Wiring": Raceway, fittings, wire, boxes and related items.
- F. "Concealed": Embedded in masonry, concrete or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures.
- G. "Or Equal. Or Approved Equal": Refers to products that, in the opinion of the DEN Project Manager, are similar in all respect to products specified by proprietary brand name. (Refer to Section 01630 for procedures for submittal of proposed substitutions.)
- H. "Exposed": Not installed underground or "concealed" as defined above.

- I. "Indicated," "Shown" or "Noted": As indicated, shown or noted on drawings or specifications.
- J. "Similar" or "Equal": Same in materials, weight, size, design, construction, capacity, performance, and efficiency of specified product.
- K. "Reviewed," "Satisfactory," "Accepted," or "Directed": As reviewed, satisfactory, accepted, or directed by or to DEN Project Manager.
- L. "Related Work" includes all "Work" required for a complete working system.
- M. "Equipment": A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an electrical installation.
- N. "Busbar": A rigid metallic conductor, lug or bar used to make a common connection between more than one circuit. (Includes all termination assemblies.)
- O. "Shall": Mandatory requirements of this specification are characterized by the use of the word "shall".
- P. Refer to Article 100 of the currently adopted National Electrical Code for other definitions as applicable to this Project.

#### 1.4 WORK SEQUENCE

- A. Construct Work in sequence under provisions of Division 1 where applicable.

#### 1.5 DRAWINGS AND SPECIFICATIONS

- A. The Drawings indicate the general arrangement of circuits, outlets, panelboards and other work. Information shown on the Drawings is schematic; however, re-circuiting will not be permitted without specific acceptance. In cases of conflict between specifications and drawings, the specification shall have precedence. Data presented on the drawings is as accurate as planning can determine, but accuracy is not guaranteed and field verification of all dimensions, locations, levels, etc., to suit field conditions is required. Review all of the Contract Documents and adjust all work to conform to all conditions shown therein.
- B. Prior to submitting a bid, a site visit is required to ascertain all conditions affecting the proposed installation and to adjust all work accordingly. Costs for providing for these adjustments, including response to site constraints, shall be itemized and listed in the bid proposal.
- C. Discrepancies between different plans, between plans and specifications, between specifications, or regulations and codes governing this installation shall be brought to the attention of the DEN Project Manager in writing 72 hours before the date of bid opening. In the event such discrepancies exist, and the DEN Project Manager is not so notified, the adjudication of responsibility shall be solely at the discretion of the

DEN Project Manager.

## 1.6 COORDINATION

- A. Prior to fabrication or installation of any electrical work, participate in detailed coordination planning meetings with all other building utilities system trades, under the direction of the General Contractor, so as to completely establish routings, elevations, space requirements, and coordination of access, layout, and suspension requirements in relationship to the building structure and the work of all other trades.
- B. Any electrical work penetrating concrete walls or floors shall require saw cutting and/or core drilling and shall require approval by the DEN Project Manager. The Contractor shall perform all necessary imaging (x-rays, etc.) as specified, and submit shop drawings of any saw cutting or core drilling to the DEN Project Manager prior to performing the Work. Refer to Section 017330 "Cutting and Patching" for additional requirements.
- C. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown.

## 1.7 COORDINATION DRAWINGS

- A. Where the Contractor modifies the design, through selection of equipment differing from that shown, coordination drawings shall be provided by the Contractor in accordance with Division 1 to a scale of 1/4"=1'0" or larger for equipment rooms, details, congested areas and sections; other plans at a scale of 1/8"=1'0". These drawings are to detail major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components.
- B. Coordination drawings shall be in accordance with current DEN standards for format, and as outlined in Division 1.
- C. The Contractor shall indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. Indicate the proposed locations of raceway systems, equipment, and materials. Include the following:
    - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
    - b. Exterior wall and foundation penetrations.
    - c. Fire-rated wall and floor penetrations.
    - d. Equipment connections and support details.
    - e. Sizes and location of required concrete pads and bases.

f. Support details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Floor plans, elevations, and appropriate details are required to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.8 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures".
- B. Submit shop drawings, coordination drawings and product data in accordance with provisions of Division 1. Submit all required information under a given specification section together. Do not split out submittals under the same specification section.
- C. Prior to submission, shop drawings, material lists and catalog cut sheets or manufacturer's printed data shall be thoroughly checked for compliance with Contract requirements, compatibility with equipment being furnished by the Contractor or Owner, accuracy of dimensions, coordination with work of other trades, and conformance with sound and safe practice as to erection of installation. Each submittal shall bear Contractor's signed statement evidencing such checking.
- D. Clearly mark each shop drawing as follows for purposes of identification:
  1. Shop Drawing.
  2. Equipment Identification Used on Contract Drawings.
  3. Date.
  4. Name of Project.
  5. Branch of Work.
  6. Project Manager's Name.
  7. Contractor's Name.
- E. Clearly mark printed material, catalog cut sheets, pamphlets or specification sheets, and shop drawings with the same designation shown on the Contract document schedules. Contractor agrees that submittals processed by the DEN Project Manager are not change orders; that the purpose of submittals is to demonstrate to the DEN Project Manager that the Contractor understands the design concept; and that the Contractor demonstrates this understanding by indicating which equipment and material the Contractor intends to furnish and install and by detailing the installation methods the Contractor intends to use.
- F. Contractor shall be responsible for dimensions (which the Contractor shall confirm and correlate at the job site), fabrication processes and techniques of construction, and coordination of the Contractor's Work with that of other trades. The Contractor shall check and verify all measurements and review shop drawings before submitting them. If any deviations from the specified requirements for any item of material or equipment exist, such deviation shall be expressly stated in writing and incorporated with the submittal.

- G. Maintain one copy of accepted shop drawings at the Project field office until completion of the Project, and make this copy available, upon request, to representatives of the DEN Project Manager and Owner.
- H. No equipment or materials shall be installed or stored at the jobsite until submittals for such equipment or materials have been given review action by the DEN Project Manager accepting their use.
- I. Shop drawings and manufacturer's published data shall be submitted for all equipment required for this Project.

#### 1.9 RECORD DOCUMENTS

- A. Maintain a Contract set of electrical drawings and specifications at the site. Neatly mark all changes, discoveries and deviations from the original drawings. Use a reproducible color that contrasts with the prints. This shall be a separate set of drawings, not used for construction purposes, and shall be updated daily as the job progresses and shall be made available for inspection by the DEN Project Manager at all times. Upon completion of the Contract, this set of record drawings shall be delivered to the DEN Project Manager. Follow current DEN BIM standards, to be furnished to the successful bidder as well as the project-specific BIM execution plan. Record documents to be provided by the Contractor shall clearly and accurately show the following:
  - 1. Provide horizontal and vertical dimensions for all raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
  - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

#### 1.10 REGULATORY REQUIREMENTS

- A. Obtain all permits, plan review, and inspections from authority having jurisdiction.
- B. The drawings and specifications take precedence when they are more stringent than codes, statutes, or ordinances in effect. Applicable codes, ordinances, standards and statutes take precedence when they are more stringent than the drawings and specifications.

#### 1.11 ENVIRONMENTAL CONDITIONS

- A. The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
  - 1. Location: Indoors/Outdoors.

2. Altitude: 5,500 feet above sea level.
3. Temperature range: -30°F to 120°F.

## 1.12 WARRANTY

- A. The entire electrical system installed under this Contract shall be left in proper working order. Replace, at no additional cost to the Owner, any work, materials, or equipment which evidences defects in design, construction, or workmanship within two (2) years, or any longer period specifically noted elsewhere in these specifications, from date of substantial completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and Equipment: Acceptable to the authority having jurisdiction as suitable for the use intended, except where more stringent requirements are indicated by the Contract Documents.
- B. All equipment and materials installed shall be new, unless otherwise specified.
- C. Defective or damaged materials shall be replaced or repaired, prior to final acceptance, in a manner acceptable to the DEN Project Manager or Owner and at no additional cost to the Owner.
- D. All electrical "equipment" and assemblies shall be acceptable for installation only if labeled and listed by a nationally recognized testing laboratory, such as UL or an equivalent.
- E. All major equipment components shall have the manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.

### 2.2 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
- B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.
- C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

### 2.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only:
  - 1. Any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions:
  - 1. Submit a request for substitution for any manufacturer not specifically named with supporting documentation for approval by DEN Project Manager.

## 2.4 PRODUCTS LIST

- A. Within fifteen (15) days after date of Notice to Proceed, submit complete list of major products required for submittal under these specifications, with name of manufacturer, trade name, and model number of each product.

## 2.5 SUBSTITUTIONS

- A. Refer to Division 1 General Requirements, Section 012510 "Substitutions".

# PART 3 - EXECUTION

## 3.1 WORKMANSHIP

- A. Only quality workmanship will be accepted. Poor workmanship, improper layout of work and lack of coordination of Work, as determined by the DEN Project Manager, are not acceptable and shall be corrected at the contractors cost.
- B. Contractor shall include no more than one apprentice per Journeyman Electrician. Apprentices shall be under the direct supervision of a licensed electrician at all times.
- C. Any changes or deviations from the drawings and specifications must be accepted in writing by the DEN Project Manager. All errors in installation shall be corrected at the expense of the Contractor. All specialties shall be installed as detailed on the drawings. Where details or specific installation requirements are not provided, manufacturer's recommendations shall be followed.
- D. Upon completion of Work, all equipment and materials shall be installed complete, thoroughly tested, checked, correctly adjusted, and left ready for intended use or operation. All Work shall be thoroughly cleaned and all residues shall be removed from surfaces. Exterior surfaces of all material and equipment shall be left in a perfect, unblemished condition.
- E. Contractor shall provide a complete installation, including all required labor, material, cartage, testing, insurance, permits, and taxes.

### 3.2 CHASES, OPENINGS, CUTTING AND PATCHING

- A. Carefully lay out all work in advance so as to eliminate where possible, cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings and roofs. Any damage to the building, structure, piping, ducts, equipment or any defaced finish shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner and to the satisfaction of the DEN Project Manager. Any necessary cutting, channeling, drilling or welding as required for the proper support, concealment, installation or anchoring of raceways, outlets, or other electrical equipment shall be performed in a careful manner, and shall be pre-approved by the DEN Project Manager.
- B. All openings made in fire-rated walls, floors, or ceilings shall be sealed and made tight in a manner to conform to the fire rating for the barrier penetrated. Reference specification Section 078413 "Penetration Firestopping" for additional information.
- C. All penetrations required through completed concrete construction shall be core drilled at minimum size required. All penetrations in concrete require an x-ray or ground penetrating radar to determine if the location is clear of reinforcing steel and embedded systems. Precautions shall be taken when drilling to prevent damage to structural concrete.

### 3.3 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical systems, equipment, and material installation with other building components. If the Contractor furnishes equipment of a different size, the Contractor shall furnish and install the proper fuses, circuit breaker, disconnect switch, wire and conduit required for the equipment furnished, at no additional cost to the Owner, and as deemed acceptable by the DEN Project Manager.

### 3.4 PROGRESS OF WORK

- A. Coordinate the progress of electrical work to conform to the progress of the Work of the other trades. Complete the entire installation as soon as the condition of the sites will permit. Any cost resulting from defective or ill-timed work performed under Division 26 shall be borne by the Contractor.

### 3.5 ELECTRICAL COMPLETION

- A. Training of Operating and Maintenance Personnel: Furnish the services of a qualified representative of the supplier of each item or system itemized below who shall instruct specific personnel, as designated by the Owner, in the operation and maintenance of that item or system.
  - 1. Instruction shall be given when the particular system is complete, shall be of the number of hours indicated, and at the time requested by the Owner. A representative of the Contractor shall be present for all demonstrations.



| <b>Systems:</b> | <b>Hours of Instruction:</b> |
|-----------------|------------------------------|
|                 |                              |
|                 |                              |
|                 |                              |

- B. Operating and Maintenance Manuals and Parts Lists: Deliver three (3) complete operating & maintenance manuals and parts lists in three-ring binders to the Owner at the time of the above required training. The information shall be provided on the manufacturer's original data sheets. Fully explain the contents of the manuals as part of required training and instruct the Owner's personnel in the correct procedure in obtaining service, both during and after the guarantee period.
  - 1. The operating and maintenance manuals and parts lists shall give complete information as to whom the Owner shall contact for service and parts. Include address and phone number. Furnish evidence that an authorized service organization regularly carries a complete stock of repair parts for these items (or systems), and that the organization is available for service. Service shall be furnished within 24 hours after requested.
- C. Operating and Acceptance Tests: Provide all labor, instruments, and equipment for the performance of tests as specified below and elsewhere in these specifications for all applicable equipment furnished and installed as part of this Contract. Submit three (3) copies of test reports to the DEN Project Manager for the DEN Project Manager's approval.
- D. Clean Up: Remove all materials, scrap, etc., relative to the electrical installation, and leave the premises and all equipment, lamps, fixtures, etc. in a clean, orderly condition. Clean all electrical equipment, such as switchboards, panel boards, luminaries etc. of construction dirt, dust, etc. and touch-up or repaint all scratches, blemishes, rust spots etc. to its original condition. Any costs to the Owner for cleanup of the site will be charged against the Contractor.
- E. Acceptance Demonstration: Upon completion of the Work, at a time to be designated by the DEN Project Manager, the Contractor shall demonstrate for the Owner the operation of the entire installation, including all systems provided or modified under this Contract.
- F. Final Acceptance by the Owner will not occur until all operating instructions are received and Owner's personnel have been thoroughly indoctrinated in the maintenance and operation of all equipment, as approved by DEN Project Manager.

## **PART 4 - MEASUREMENT**

### **4.1 METHOD OF MEASUREMENT**

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

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

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

END OF SECTION **260400**

## SECTION 260510 - TESTING, ACCEPTANCES AND CERTIFICATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY OF REQUIREMENTS

- A. The Contractor shall provide the necessary field-testing and startup services for all electrical and mechanical equipment except as noted otherwise. The field-testing and startup services shall be in accordance with each equipment manufacturer's written recommendations for field-testing proving they meet Contract standards.
- B. The Contractor shall be responsible for furnishing all equipment, power source when needed, coordinating and performing electrical/electronic testing required by the Contract Documents. Testing requirements may be located on the Contract Drawings or other sections of the specifications.
- C. The Contractor shall provide all necessary assistance and cooperation with any Independent Testing Organization furnishing by the City. The Contractor shall correct, repair, or replace all equipment found to be defective by the Independent Testing Organization.

#### 1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all Work specified herein shall conform to or exceed the applicable requirements of the referenced Standards; provided, that wherever the provisions of said publications are in conflict with the requirements specified herein, the more stringent requirements shall apply unless in conflict with the equipment manufacturer's written recommendations:
  - 1. Building Code and DEN Standards.
  - 2. ANSI/IEEE C2 - National Electrical Safety Code.
  - 3. OSHA - Occupational Safety and Health Administration, as Amended
  - 4. NETA - National Electric Testing Association
  - 5. NEMA ICS 1 - General Standards for Industrial Control and Systems.
  - 6. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
  - 7. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
  - 8. UL 1008 - Standard for Automatic Transfer Switches.
  - 9. NFPA 70 - National Electrical Code, including but not limited to use in emergency and standby systems in accordance with Articles 517, 700, 701 and 702.

10. NFPA 72 - National Fire Alarm Code (as adopted and amended by the Denver Building Code and DEN Standards).
11. NFPA 101 - National Electrical Safety Code (as adopted and amended by the Denver Building Code and DEN Standards).
12. NFPA 110 - Standard for Emergency and Standby Power Systems (as adopted and amended by the Denver Building Code and DEN Standards).
13. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)
14. NEMA Standard ICS-2-447 - AC Automatic Transfer Switches.
15. IEC - Standard for Automatic Transfer Switches.

#### 1.4 SUBMITTALS

- A. Comply with Division 1 submittal requirements.
- B. Five (5) copies of complete certified test reports shall be submitted to the DEN Project Manager by the contractor. Electronic copy of test reports in pdf format to also be submitted to the DEN Project Manager. The test reports shall include the following as a minimum:
  1. Power cable high potential test reports:
    - a. Insulation resistance tests.
    - b. Continuity tests.
  2. Transformer test reports to include where applicable:
    - a. Transformer turns ratio.
    - b. Winding resistance.
    - c. Insulation power factor.
    - d. K Factor.
  3. All electrical/electronic equipment and systems functional test report.
  4. All other reports required by individual specification sections.
  5. Generator load bank test report.
  6. Transfer Switch test report.
  7. Load balance report for each switch board, panel board and switch gear.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. The electrical and mechanical equipment shall be completely tested in the field in the presence of DEN Inspectors in accordance with good and accepted industry engineering practices to assure that:
  1. The equipment has not been damaged during manufacturing, shipping, or installation.

2. The equipment has been installed according to the requirements Contract Documents.
  3. The equipment meets the requirements of the Contract Documents.
- B. If the Contractor finds during the testing that any piece of equipment failed to satisfactorily pass the required field test, the DEN Project Manager shall be promptly notified and the Contractor shall take the necessary actions for the prompt repair or replacement.
- C. A retest to demonstrate the equipment will meet the requirements of the Contract Documents shall be scheduled with the DEN Project Manager.
- 2.2 ENGINE GENERATOR SYSTEM (WHEN FURNISHED AND INSTALLED AS PART OF THIS CONTRACT).
- A. Test generator operation per tests as specified in Section 263213 "Engine Generators".
- 2.3 BYPASS ISOLATION TRANSFER SWITCH (WHEN FURNISHED AND INSTALLED AS PART OF THIS CONTRACT).
- A. Test transfer switch operation per tests as specified in Section 263600 "Transfer Switches"
- 2.4 HVAC
- A. Test the operation of all heaters and air conditioners.
- B. Test the Lead Lag Control circuits.
- 2.5 GROUND RESISTANCE TEST
- A. Before connecting a ground rod to the system test the resistance to earth. Where test show resistance to ground over 5 OHMS, an additional ground rod shall be added.
- B. Upon completion of installation of electrical grounding system, test ground resistance to earth in accordance with ANSI/IEEE81. Submit test results to the DEN Project Manager
- 2.6 CONDUCTOR INSULATION TEST
- A. Prior to energizing, all building service cables feeders to and/or from transformers, switchboards, panel boards are to be tested with a 1000-volt insulation megohm meter to determine insulation resistance levels. Test cables rated for three hundred volt with a 500-volt megohm meter or as recommended by the manufacturer. All field test data is to be recorded, corrected to a baseline temperature and furnished to the DEN

Project Manager. A test is to include meggering between conductors and between each conductor and ground. Cables are to be meggered after installation with cables disconnected at both ends. Insulation test values shall meet or exceed the values given below:

| <b>Conductor Size:</b><br>(AWG or KCMIL) | <b>Resistance:</b><br>(Megohms - 1,000 ft.) |
|------------------------------------------|---------------------------------------------|
| 12-8                                     | 200                                         |
| 6-2/0                                    | 100                                         |
| 3/0-750                                  | 100                                         |

### **PART 3 - EXECUTION**

#### **3.1 FIELD QUALITY CONTROL**

##### **A. TESTING**

1. The Contractor shall allow only certified personnel to perform the testing.
2. The Contractor shall perform the testing using all necessary safety precautions and proper test equipment.
3. The Contractor shall notify the DEN Project Manager three (3) days in advance of the proposed testing dates.
4. Witness of testing by DEN Inspector, Electrical Maintenance and Electrical Inspector.

### **PART 4 - MEASUREMENT**

#### **4.1 METHOD OF MEASUREMENT**

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

### **PART 5 - PAYMENT**

#### **5.1 METHOD OF PAYMENT**

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

END OF SECTION 260510

## SECTION 260513 - MEDIUM-VOLTAGE CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. Jacket: A continuous nonmetallic outer covering for conductors or cables.
- B. NETA ATS: Acceptance Testing Specification.
- C. Sheath: A continuous metallic covering for conductors or cables.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.
- B. Samples: 16-inch (400-mm) lengths for each type of cable specified.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer.
- B. Material Certificates: For each type of cable and accessory, signed by manufacturers.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Torque Values: Submit torque values for all connections with a torque schedule and witness signature.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C2 and NFPA 70.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated.
- B. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown. Do not proceed with interruption of electric service without Owner's written permission.
- C. Any electrical work penetrating concrete walls or floors shall require saw cutting and/or core drilling and shall require approval by the DEN Project Manager. The contractor shall submit shop drawings of any saw cutting or core drilling to the DEN Project Manager prior to performing the work. Refer to Section 033000 "Cast-In-Place Concrete" for cutting and patching work.
- D. CONSTRUCTION WASTE MANAGEMENT
  - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall



be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Cables:

- a. American Insulated Wire Corp.; a Leviton Company.
- b. General Cable Technologies Corporation.
- c. Kerite Co. (The); Hubbell Incorporated.
- d. Okonite Company (The).
- e. Pirelli Cables & Systems NA.
- f. Rome Cable Corporation.
- g. Southwire Company.
- h. **<Insert manufacturer>**
- i. or approved equal.

2. Cable Splicing and Terminating Products and Accessories:

- a. Engineered Products Company.
- b. G&W Electric Company.
- c. MPHusky.
- d. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
- e. RTE Components; Cooper Power Systems, Inc.
- f. Scott Fetzer Co. (The); Adalet.
- g. Thomas & Betts Corporation.
- h. Thomas & Betts Corporation/Elastimold.
- i. 3M; Electrical Products Division.
- j. **<Insert manufacturer>**
- k. or approved equal.

### 2.2 CABLES

- A. Cable Type: [ **MV90**] [**MV105.**]
- B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682 , ICEA S-94-649.
- C. Conductor: Copper.
- D. Conductor Stranding: [**Compact round, concentric lay, Class B**] [**Concentric lay, Class B**].

- E. Strand Filling: Conductor interstices are filled with impermeable compound.
- F. Conductor Insulation: Crosslinked polyethylene.
- G. Conductor Insulation: Ethylene-propylene rubber.
  - 1. Voltage Rating: [5] [8] [15] [25] [35] kV.
  - 2. Insulation Thickness: [100] [133] percent insulation level.
- H. Shielding: [Copper tape] [Solid copper wires], helically applied over semiconducting insulation shield.
- I. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.
  - 1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.

## 2.3 SPLICE KITS

- A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.
  - 1. Combination tape and cold-shrink-rubber sleeve kit with re-jacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
  - 2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
  - 3. Premolded, cold-shrink-rubber, in-line splicing kit.
  - 4. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

## 2.4 SOLID TERMINATIONS

- 1. Multiconductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.
  - 2. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.
  - 3. Heat-shrink sheath seal kit with phase- and ground-conductor re-jacketing tubes, cable-end sealing boot, and sealing plugs for unused ground-wire openings in boot.
  - 4. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged, two-part, epoxy-resin casting material.
- B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable

terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
  2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
  3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
  4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
  5. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape; cold-shrink-rubber sleeve; or heat-shrink, plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
  6. Class 3 Terminations: Kit with stress cone and compression-type connector.
- C. Nonshielded-Cable Terminations: Kit with compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.

## 2.5 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- C. Load-Break Cable Terminators: Elbow-type units with 200-A-load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

## 2.6 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: **10-mil-** (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to **0.3 inch** (8 mm) thick, and compatible with cable jacket.
- C. Glass-Cloth Tape: Pressure-sensitive adhesive type, **1 inch** (25 mm) wide.

## 2.7 FAULT INDICATORS

- A. Indicators: [**Automatically**] [**Manually**] reset fault indicator[ **with inrush restraint feature**], arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.
- B. Resetting Tool: Designed for use with fault indicators, with moisture-resistant storage and carrying case.

## 2.8 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to [ICEA S-97-682] [ICEA S-94-649] before shipping.
- B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of **5 psig** (35 kPa).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Determine required separation between wiring and other work.
- C. Determine routing to avoid interference with other work.
- D. Minimum wire size shall be based on the over current protection device and as governed by the NEC.
- E. Place an equal number of conductors for each phase in the same raceway.
- F. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
  - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
  - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
  - 3. Pulling winches and other necessary pulling equipment shall be of adequate capacity to ensure a continuous pull on the cable. Strain gages shall be used to monitor the cable pulling tension.
  - 4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
  - 5. Pull all conductors into a raceway at the same time.
  - 6. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- G. Neatly train and lace wiring inside boxes, equipment, and panel boards. Make temporary connections to panel board devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.
- H. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- I. All building wire and cable shall be installed in an approved raceway.
- J. All buried conduits containing medium-voltage cabling shall be installed in concrete encased duct banks.
- K. Install "Caution- Medium-Voltage" warning tape at least **12 inches** (305 mm) above concrete encased duct banks.
- L. Conductors shall not be pulled in concrete encased conduits before concrete is placed.

- M. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.
- N. Install cable splices at pull points and elsewhere as indicated; use standard kits.
- O. Install terminations at ends of conductors and seal multiconductor cable ends with standard kits.
- P. Install separable insulated-connector components as follows:
  - 1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
  - 2. Portable Feed-Through Accessory: Three.
  - 3. Standoff Insulator: Three.
- Q. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
  - 1. Clean cable sheath.
  - 2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
  - 3. Smooth surface contours with electrical insulation putty.
  - 4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
  - 5. Band arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape 2 inches (50 mm) o.c.
- R. Where harmonic currents exist on circuits that supply electric discharge lighting, data processing or similar equipment, a full size neutral conductor shall be provided for each single-phase circuit.
- S. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."
- T. Install fault indicators on each phase where indicated.
- U. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- V. Identify cables according to Section 260553 "Identification for Electrical Systems."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
  - 2. Field inspection and testing will be performed under provisions of Division 01.
  - 3. Inspect wire and cable for physical damage and proper connection.

4. Torque conductor connections and terminations to manufacturer's recommended values. Submit torque values for all connections with a torque schedule and witness signature.
5. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
6. Perform continuity test on all feeder and branch circuit conductors. Verify proper phasing connections.
7. Verify cables are colored coded and labeled according to contract documents.
8. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
9. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
10. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
11. Medium-voltage cables will be considered defective if they do not pass tests and inspections.
12. Prepare test and inspection reports.

#### **PART 4 - MEASUREMENT**

##### **4.1 METHOD OF MEASUREMENT**

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

#### **PART 5 - PAYMENT**

##### **5.1 METHOD OF PAYMENT**

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

END OF SECTION 260513

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## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
  - 1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
  - 2. Division 26 Section "Undercarpet Electrical Power Cables" for flat cables for undercarpet installations.
  - 3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 ACTION SUBMITTALS

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



1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.8 CONSTRUCTION WASTE MANAGEMENT

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

**PART 2 - PRODUCTS**

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Insulated Wire Corp.; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Southwire Company.
  - 4. Encore Wire Corp.
  - 5. Cerro Wire and Cable Company.
  - 6. CME Wire.
  - 7. Coleman Cable Inc.
  - 8. <Insert manufacturer>
  - 9. or approved equal.
- B. All conductors shall be copper.

- C. AC cable and Modular wiring are not permitted.
- D. MC Cable: Comply with NEMA WC 70. Provide internal equipment grounding conductor throughout.
- E. Copper Conductors: Comply with NEMA WC 70.
- F. Conductor Insulation: Comply with NEMA WC 70 for Types [THW] [THHN-THWN] [XHHW].
- G. Remote Control and Signal Cable
  - 1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated at 60 deg C, individual conductors twisted together, shielded, and covered with a PVC jacket.
  - 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

## 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
  - 6. Ideal.
  - 7. <Insert manufacturer>
  - 8. or approved equal.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except for connection to vibrating equipment then stranded shall be used.
- C. Prohibited Cable Types: UF, NM, SE, AC.

- 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Minimum wire size shall be based on the over current protection device and as governed by the NEC.
  - B. Service Entrance: **[Type THHN-THWN, single conductors in raceway] [Type XHHW, single conductors in raceway].**
  - C. Exposed Feeders: **[Type THHN-THWN, single conductors in raceway], [Type XHHW, single conductors in raceway].**
  - D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: **[Type THHN-THWN, single conductors in raceway], [Type XHHW, single conductors in raceway].**
  - E. Feeders below Slabs-on-Grade, and Underground: **[Type THHN-THWN, single conductors in raceway], [Type XHHW, single conductors in raceway].**
  - F. Feeders Installed below Raised Flooring: **[Type THHN-THWN, single conductors in raceway], [Type XHHW, single conductors in raceway].**
  - G. Feeders in Cable Tray: **[Type THHN-THWN, single conductors in raceway], [Type XHHW, single conductors in raceway].**
  - H. Exposed Branch Circuits, Including in Crawlspace: **[Type THHN-THWN, single conductors in raceway].**
  - I. Branch Circuits Concealed in Ceilings, Walls, and Partitions: **[Type THHN-THWN, single conductors in raceway].**
  - J. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: **[Type THHN-THWN, single conductors in raceway].**
  - K. Branch Circuits Installed below Raised Flooring: **[Type THHN-THWN, single conductors in raceway].**
  - L. Branch Circuits in Cable Tray: **[Type THHN-THWN, single conductors in raceway].**
  - M. Class 1 Remote Control and Signal Circuits: Type THHN-THWN, in raceway or cable tray as applicable, or Copper conductor, 600 volt insulation, individual conductors twisted together, shielded, and covered with a PVC jacket.
  - N. Class 2 Remote Control and Signal Circuits: Type THHN-THWN, in raceway or cable tray as applicable, or Copper conductor, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
  - O. All power, control, data, communication and signal wire or cable shall be installed in an approved raceway.

- P. MC Cable allowed for use in 20-Ampere branch circuits, with the following conditions:
1. Cable shall be run concealed in all locations. Where circuiting must be exposed, provide single conductor building wire in approved raceway.
  2. Home run from first device to panel board shall be single conductor building wire in approved raceway.
  3. MC cable shall be supported using approved methods throughout. Do not run cables unsupported in any area, including above accessible ceilings, in unfinished areas, etc.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. All power, control, data, communication and signal wire or cable shall be installed in an approved raceway (raceway shall be defined as conduit or cable tray as applicable).
- B. Verify raceways are open, continuous and clear of debris before installing cables.
- C. Pull all conductors into a raceway at the same time. Use a listed wire pulling lubricant for pulling No. 4 AWG and larger wires.
- D. Completely and thoroughly swab raceway system before installing conductors for conduit in floors, concrete, or below grade.
- E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- F. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- H. Pulling winches and other necessary pulling equipment shall be of adequate capacity to ensure a continuous pull on the cable. Strain gages shall be used to monitor the cable pulling tension.
- I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- J. Neatly train wiring inside boxes, equipment, and panel boards. Make temporary connections to panel board devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.
- K. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- L. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

- M. Conductors shall not be pulled in concrete encased conduits before concrete is placed.
- N. For connection to vibrating equipment, stranded wire shall be used.
- O. All wiring shall be installed in a new approved raceway system. Existing conduits shall not be used unless approved by the DEN Project Manager.
- P. Where harmonic currents exist on feeders that supply panelboards that serve electronic equipment of 40 percent or more of the panelboards total ampacity, two (2) full size neutral conductors or a neutral conductor rated at 200 percent shall be provided to the panelboard being served. A neutral bus bar rated at 200 percent shall also be provided in the panelboard.
- Q. Shared Neutrals: Prohibited. A full-size neutral conductor shall be provided for each single-phase circuit.

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Splice only in accessible junction and outlet boxes.
- C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- D. Wiring at Outlets: Install conductor at each outlet, with at least [**6 inches (150 mm)**] [**12 inches (300 mm)**] of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Field inspection and testing will be performed under provisions of Division 01.
  - 2. After installing conductors and cables and before electrical circuitry has been energized, test[ **service entrance and feeder conductors, and conductors feeding the following critical equipment and services**] for compliance with requirements.
    - a. Prior to energizing, all building service cables, feeders to and/or from transformers, switchboards and panel boards are to be tested with a 500-volt insulation megohm meter to determine insulation resistance levels. All field test data is to be recorded, corrected to a baseline temperature and furnished to the DEN Project Manager. A test is to include meggering for one minute between conductors and between each conductor and ground. Cables are to be meggered after installation with cables disconnected at both ends. Insulation test values shall meet or exceed the values given below.

| <b>Conductor Size (AWG or KCMIL):</b> | <b>Resistance (Megaohms-1,000ft):</b> |
|---------------------------------------|---------------------------------------|
| 12-8                                  | 200                                   |
| 6-2/0                                 | 100                                   |
| 3/0-750                               | 100                                   |

- 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
  - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice eleven (11) months after date of Substantial Completion.
  - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 4. Inspect wire and cable for physical damage and proper connection.

- B. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Cables will be considered defective if they do not pass tests and inspections.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 PAYMENT

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

END OF SECTION 260519

## SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. UTP cabling.
  - 2. 50/125 62.5/125-micrometer, multimode optical fiber cabling.
  - 3. RS-232 cabling.
  - 4. RS-485 cabling.
  - 5. Low-voltage control cabling.
  - 6. Control-circuit conductors.
  - 7. Identification products.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- G. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).



- H. RCDD: Registered Communications Distribution Designer.
- I. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- J. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- K. UTP: Unshielded twisted pair.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - 1. Vertical and horizontal offsets and transitions.
  - 2. Clearances for access above and to side of cable trays.
  - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - 4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wire and cable to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: **[25] <Insert value>** or less.
  - 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use **[optical fiber flashlight] [optical loss test set] [optical fiber flashlight or optical loss test set] <Insert test>**.
  - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP and optical fiber cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of **[Category 5e] [Category 6] <Insert other cabling types>** cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cable Management Solutions, Inc.
  - b. Cablofil Inc.
  - c. Cooper B-Line, Inc.
  - d. Cope - Tyco/Allied Tube & Conduit.
  - e. GS Metals Corp.
  - f. **<Insert manufacturer>**
  - g. or approved equal.
2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by **[electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick]** **[hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick]**.
  - a. Basket Cable Trays: **[6 inches (150 mm) wide and 2 inches (50 mm) deep]** **<Insert dimensions>**. Wire mesh spacing shall not exceed **2 by 4 inches (50 by 100 mm)**.
  - b. Trough or Ventilated Cable Trays: **[Nominally 6 inches (150 mm)] <Insert dimension>** wide.
  - c. Ladder Cable Trays: **[Nominally 18 inches (455 mm)] <Insert dimension>** wide, and a rung spacing of **[12 inches (305 mm)] <Insert dimension>**.
  - d. Channel Cable Trays: One-piece construction, **[nominally 4 inches (100 mm)] <Insert dimension>** wide. Slot spacing shall not exceed **4-1/2 inches (115 mm) o.c.**
  - e. Solid-Bottom or Nonventilated Cable Trays: One-piece construction, **[nominally 12 inches (305 mm)] <Insert dimension>** wide. Provide **[with]** **[without]** solid covers.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."**[ Flexible metal conduit shall not be used.]**

1. Outlet boxes shall be no smaller than **2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.**

2.2 BACKBOARDS

- A. Description: Plywood, **[fire-retardant treated, ]3/4 by 48 by 96 inches (19 by 1220 by 2440 mm)**. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry."

## 2.3 UTP CABLE

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

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
13. <Insert manufacturer>
14. or approved equal.

B. Description: 100-ohm, four-pair UTP[, **formed into 25-pair binder groups covered with a blue thermoplastic jacket**].

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, [**Category 5e**] [**Category 6**].
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
  - a. Communications, General Purpose: Type CM or Type CMG[; **or Type MPP, Type CMP, Type MPR, Type CMR, Type MP, or Type MPG**].
  - b. Communications, Plenum Rated: Type CMP[ **or Type MPP**], complying with NFPA 262.
  - c. Communications, Riser Rated: Type CMR[; **or Type MPP, Type CMP, or Type MPR**]; complying with UL 1666.
  - d. Communications, Limited Purpose: Type CMX[; **or Type MPP, Type CMP, Type MPR, Type CMR, Type MP, Type MPG, Type CM, or Type CMG**].
  - e. Multipurpose: Type MP or Type MPG[; **or Type MPP or Type MPR**].
  - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
  - g. Multipurpose, Riser Rated: Type MPR[ **or Type MPP**], complying with UL 1666.

## 2.4 UTP CABLE HARDWARE

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

1. American Technology Systems Industries, Inc.
2. Dynacom Corporation.

3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
11. **<Insert manufacturer>**
12. or approved equal.

- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- C. Connecting Blocks: 110 style for Category 5e 110 style for Category 6 66 style for Category 5e. Provide blocks for the number of cables terminated on the block, plus percent spare; integral with connector bodies, including plugs and jacks where indicated.

## 2.5 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berk-Tek; a Nexans company.
  2. CommScope, Inc.
  3. Corning Cable Systems.
  4. General Cable Technologies Corporation.
  5. Mohawk; a division of Belden CDT.
  6. Nordex/CDT; a subsidiary of Cable Design Technologies.
  7. Optical Connectivity Solutions Division; Emerson Network Power.
  8. Superior Essex Inc.
  9. SYSTIMAX Solutions; a CommScope, Inc. brand.
  10. 3M.
  11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
  12. **<Insert manufacturer>**
  13. or approved equal.
- B. Description: Multimode, 50/125 62.5/125-micrometer, -fiber, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
  2. Comply with TIA/EIA-568-B.3 for performance specifications.
  3. Comply with **[TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A]** for detailed specifications.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

- a. General Purpose, Nonconductive: Type OFN or OFNG[, or **Type OFNR or Type OFNP**].
  - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
  - c. Riser Rated, Nonconductive: Type OFNR[ or **Type OFNP**], complying with UL 1666.
  - d. General Purpose, Conductive: Type OFC or Type OFCG[; or **Type OFNG, Type OFN, Type OFCR, Type OFNR, Type OFCP, or Type OFNP**].
  - e. Plenum Rated, Conductive: Type OFCP[ or **Type OFNP**], complying with NFPA 262.
  - f. Riser Rated, Conductive: Type OFCR[; or **Type OFNR, Type OFCP, or Type OFNP**]; complying with UL 1666.
5. Conductive cable shall be [**steel**] [**aluminum**]-armored type.
  6. Maximum Attenuation: [**3.5**] <Insert number> dB/km at 850 nm; [**1.5**] <Insert number> dB/km at 1300 nm.
  7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: [**Aqua for 50/125**] [**Orange for 62.5/125**]-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed **40 inches** (1000 mm).

## 2.6 OPTICAL FIBER CABLE HARDWARE

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

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).
11. <Insert manufacturer>
12. or approved equal.

B. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, [**Type SC**] [**Type ST**] [**Type LC**] [**Type MT-RJ**] connectors. Insertion loss not more than 0.75 dB.

2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.7 RS-232 CABLE

### A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1581.

### B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

## 2.8 RS-485 CABLE

### A. Standard Cable: NFPA 70, Type CM[ or Type **CMG**].

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

### B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

## 2.9 LOW-VOLTAGE CONTROL CABLE

### A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

### B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

### C. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

### D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

## 2.10 CONTROL-CIRCUIT CONDUCTORS

### A. Class 1 Control Circuits: Stranded copper, [Type THHN-THWN] [Type XHHN], in raceway, complying with [UL 83] [UL 44].

### B. Class 2 Control Circuits: Stranded copper, [Type THHN-THWN, in raceway] [Type XHHN, in raceway] [power-limited cable, concealed in building finishes] [power-limited tray cable, in cable tray], complying with [UL 83] [UL 44].

### C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

## 2.11 IDENTIFICATION PRODUCTS

### A. Manufacturers: Subject to compliance with requirements, provide products by one of



the following:

1. Brady Corporation.
  2. HellermannTyton.
  3. Kroy LLC.
  4. Panduit Corp.
  5. <Insert manufacturer>
  6. or approved equal.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.
- E. Pathway Installation in Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering room from overhead.
4. Extend conduits [3 inches (75 mm)] <Insert dimension> above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.

- B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

- D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260553 "Raceway and Boxes for Electrical Systems."

- E. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

F. Open-Cable Installation:

1. Open-Cable installation is prohibited. All cables shall be installed in an approved raceway.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [72 inches (1830 mm)] <Insert size> long shall be neatly coiled not less than [12 inches (305 mm)] <Insert size> in diameter below each feed point.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of **48 inches** (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of **5 inches** (127 mm).

### 3.3 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove all abandoned conductors and cables.

### 3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
  1. Class 1 remote-control and signal circuits, **[No 14]** <Insert wire size> AWG.
  2. Class 2 low-energy, remote-control, and signal circuits, **[No. 16]** <Insert wire size> AWG.
  3. Class 3 low-energy, remote-control, alarm, and signal circuits, **[No 12]** <Insert wire size> AWG.

### 3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.6 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

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

#### **PART 5 - PAYMENT**

##### 5.1 PAYMENT

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

END OF SECTION 260523

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Overhead-line grounding.
  - 2. Underground distribution grounding.
  - 3. Ground bonding common with lightning protection system.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to the metallic water pipe service on building side only and to supplementary grounding electrodes, as required by the contract documents and as required by the NEC.
- B. External (underground) metal pipes, water, gas, fuel, drain/sewer etc., are not available for electrical grounding. This is due to extensive cathodic protection and isolation joints of all underground metal pipes at DEN. These systems shall be bonded to the grounding system on the building side only.
- C. Ground each separately derived system neutral to nearest building steel or referenced ground plate in the electrical room.
- D. Provide a 2/0 minimum building perimeter-grounding conductor buried thirty inches (30") below finished grade thirty-six inches (36") from foundation.
- E. Provide a minimum of three inch by twelve inch by one-quarter inch (3" x 12" x ¼") copper ground bar in the electrical room for connecting the grounding systems.
- F. An insulated equipment ground conductor shall be installed continuous from the main switchgear or service entrance to all branch panelboards, motor control centers, transformers and all motors. This conductor shall be bonded to the conduit and metal

enclosures that it passes through utilizing bonding bushings and terminal devices.

#### 1.4 ACTION SUBMITTALS

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

1. Include data substantiating that materials comply with requirements.

B. Shop Drawings:

1. Submit shop drawings, coordination drawings, and product data in accordance with provisions of Division 1. Submit all required information under a given specification section together. Do not split out submittals under the same specification section.

a. Clearly mark each shop drawing as follows for purposes of identification:

- 1) Shop Drawing
- 2) Equipment Identification Used on Contract Drawings
- 3) Date
- 4) Name of Project
- 5) Branch of Work
- 6) Project Manager's Name
- 7) Contractor's Name

b. Indicate layout of ground ring, location of system grounding electrode connections, and routing of grounding electrode conductors.

C. Prior to submission, shop drawings, material lists and catalog cut sheets or manufacturer's printed data shall be thoroughly checked for compliance with contract requirements, compatibility with equipment being furnished by the Contractor or Owner, accuracy of dimensions, coordination with work of other trades, and conformance with sound and safe practice as to erection of installation. Each submittal shall bear Contractor's signed statement evidencing such checking.

D. Clearly mark printed material, catalog cut sheets, pamphlets or specification sheets, and shop drawings with the same designation shown on the Contract Document schedules.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. Grounding for sensitive electronic equipment.



6. **<Insert items>**.

- B. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

- 1. Instructions for periodic testing and inspection of grounding features at [**test wells**] [**ground rings**] [**grounding connections for separately derived systems**] **<Insert locations>** based on [**NETA MTS**] [**NFPA 70B**] **<Insert reference>**.
- 2. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- 3. Include recommended testing intervals.

- B. Record Documents

- 1. Maintain a contract set of electrical drawings and specifications at the site. Neatly mark all changes, discoveries, and deviations from the original drawings. Use a reproducible color that contrasts with the prints. This shall be a separate set of drawings, not used for construction purposes, and shall be updated daily as the job progresses and shall be made available for inspection by the DEN Project Manager at all times. Upon completion of the contract, this set of record drawings shall be delivered to the DEN Project Manager. Follow DEN BIM standards, to be furnished to the successful bidder. Record documents to be provided by the Contractor shall clearly and accurately show the following:
  - a. Provide horizontal and vertical dimensions for all raceway systems, size, and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
  - b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - c. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

## 1.8 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Codes.
- B. All ground wires shall be copper, sized according to the NEC or as shown on the drawings whichever is larger.
- C. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
- D. Bare Grounding Conductor and Conductor Protector for Wood Poles:
  - 1. No. 4 AWG minimum, soft-drawn copper.
  - 2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.
- E. Grounding Bus: Predrilled rectangular bars of annealed copper, [**1/4 by 4 inches (6.3 by 100 mm)**] **<Insert dimensions>** in cross section, with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

### 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Exothermic welded connections are required where grounding conductors connect to underground grounding conductors and to underground grounding electrodes, and for bonding to steel. All underground connections shall be exothermic welded.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Grounding Connection Accessories:
  1. Electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type of service required.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: [**Copper-clad**] [**Zinc-coated**] [**Stainless steel**]; [**sectional type**]; **3/4 inch by 10 feet** (19 mm by 3 m) in diameter.
- B. Ground Rods in manholes ground rods shall be stainless steel 3/4-inch diameter and a minimum length of 10 feet.
- C. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with [**nonhazardous electrolytic chemical salts**] **<Insert enhancement material>**.
  1. Termination: Factory-attached No. 4/0 AWG bare conductor at least **48 inches** (1200 mm) long.
  2. Backfill Material: Electrode manufacturer's recommended material.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. [**12**] **<Insert size>** AWG and smaller, and stranded conductors for No. [**10**] **<Insert size>** AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare [**tinned-**]copper conductor, No. [**2/0**] **<Insert size>** AWG minimum.
  1. Bury at least **30 inches** (750 mm) below grade.
  2. Duct-Bank Grounding Conductor: Bury **12 inches** (300 mm) above duct bank when indicated as part of duct-bank installation.

- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers **2 inches (50 mm)** minimum from wall, **6 inches (150 mm)** above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of doorframe, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING OVERHEAD LINES

- A. Comply with IEEE C2 grounding requirements.
- B. Install [**two (2)**] <Insert number> parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are **12 inches (300 mm)** below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so **4 inches (100 mm)** will extend above

finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
  - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment.

- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
  - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final

grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  2. For grounding electrode system, install at least [**three (3)**] <Insert number> rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least **12 inches** (300 mm) deep, with cover.
1. Test Wells: Install at least one (1) test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Retain and revise first paragraph below to exceed NFPA 70 requirements, and comply with NFPA 70 recommendations for a higher standard of safety or electromagnetic interference suppression if needed.
- H. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install [**tinned**] bonding jumper to bond across flexible duct connections to achieve continuity.

- I. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- J. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each **[steel column] [indicated item]**, extending around the perimeter of **[building] [area or item indicated]**.
  1. Install tinned-copper conductor not less than No. **[2/0] <Insert size>** AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than **[24 inches (600 mm)] <Insert dimension>** from building's foundation.
- K. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of **[20 feet (6 m)] <Insert length>** of bare copper conductor not smaller than No. **[4] <Insert size>** AWG.
  1. If concrete foundation is less than **[20 feet (6 m)] <Insert dimension>** long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

### 3.6 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" Article for instruction signs.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer **[and at the grounding electrode conductor where exposed]**.
  1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.



3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal[, **at ground test wells**] [, **and at individual ground rods**]. Make tests at ground rods before any conductors are connected.
  4. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  5. Perform tests by fall-of-potential method according to IEEE 81.
  6. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **[10] <Insert value>** ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **[5] <Insert value>** ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **[3] <Insert value>** ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: **[1] [3] <Insert value>** ohm(s).
  5. Substations and Pad-Mounted Equipment: **[5] <Insert value>** ohms.
  6. Manhole Grounds: **[10] <Insert value>** ohms.
  7. **<Insert application and maximum ground-resistance value>** ohms.
  8. Ground resistance to earth of each ground rod: > 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify DEN Electrical Engineer promptly and include recommendations to reduce ground resistance.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

5.1 PAYMENT

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

## **SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### **1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.
3. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.10 CONSTRUCTION WASTE MANAGEMENT

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

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Tube & Conduit.
  - b. Cooper B-Line, Inc.; a division of Cooper Industries.
  - c. ERICO International Corporation.
  - d. GS Metals Corp.
  - e. Thomas & Betts Corporation.
  - f. Unistrut; Tyco International, Ltd.
  - g. Wesanco, Inc.
  - h. <Insert manufacturer>
  - i. or approved equal.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4. For use in dry locations only.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with **9/16-inch (14-mm)** diameter holes at a maximum of **8 inches (200 mm)** o.c., in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Tube & Conduit.
  - b. Cooper B-Line, Inc.; a division of Cooper Industries.
  - c. Fabco Plastics Wholesale Limited.
  - d. Seasafe, Inc.
  - e. <Insert manufacturer>
  - f. or approved equal.
2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles[, **except metal items may be stainless steel**].
4. Rated Strength: Selected to suit applicable load criteria.

C. Hardware for hangers and supports shall be corrosion-resistant.

- D. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- E. Conduit and Cable Support Devices: **[Steel] [Steel and malleable-iron]** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- F. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, **[zinc-coated] [stainless]** steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
      - 6) **<Insert manufacturer>**
      - 7) or approved equal.
  2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  5. Toggle Bolts: All-steel springhead type.
  6. Hanger Rods: Threaded steel.
  7. Pneumatic-Actuated Fasteners: For use in ceilings only and by approval of DEN Project Manager. Powder-actuated tools are prohibited. Threaded-steel stud, for use in pan deck cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Hilti Inc.
- 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 3) MKT Fastening, LLC.
- 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
- 5) **<Insert manufacturer>**
- 6) or approved equal.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as **[required by] [scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in] NFPA 70**. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted **[or other ]** support system, sized so capacity can be increased by at least **[25] <Insert number>** percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with **[two-bolt conduit clamps] [single-bolt conduit clamps] [single-bolt conduit clamps using spring friction action for retention in support channel]**.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in

NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps, as appropriate and with sufficient weight rating for the application.
  6. To Light Steel: Sheet metal screws.
  7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate **[ by means that meet seismic-restraint strength and anchorage requirements for a seismic zone 1.]**
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit.
- G. The use of pneumatic-actuated anchors is not allowed except at ceilings. Obtain DEN Project Manager approval prior to ordering materials or performing work.
- H. Do not drill structural steel members.
- I. Install surface-mounted cabinets and panelboards with minimum of four anchors
- J. Suspended conduit or box supports shall not be less than 1/4" diameter steel rod. Rod used as pedestal support is not acceptable. The contractor shall not use tie wire or wire of any type to support conduits, junction boxes or pull boxes.
- K. No more than five (5) 1/2" conduits, three (3) 3/4" conduits or two (2) 1" conduits shall be supported on a single 1/4" diameter steel rod.
- L. All conduits shall be supported by approved hangers. Supports installed and used by other trades such as duct hangers, pipe hangers, ceiling hangers, etc. shall not be used for conduit support.



- M. All light fixtures shall be independently supported at opposite corners from structure, or from trapeze supported from structure by the electrical contractor.
- N. Wall-mounted fixtures shall be supported from building structure with backing support as approved by the DEN Project Manager to prevent any damage to the wall.
- O. Use vibration isolation pads for vibrating equipment such as transformers.
- P. Plastic or fiber anchors are prohibited.
- Q. Anchoring in overhead cast in place, pre-tensioned or post-tensioned concrete is prohibited unless x-ray or ground penetrating radar study are performed and approved by the DEN Project Manager.
- R. Route conduit through roof openings provided for piping and ductwork where possible; otherwise, route through roof jack with sealant approved by the roofing manufacturer.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Install all freestanding electrical equipment on a 4" concrete housekeeping pad.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- C. Use [3000-psi (20.7-MPa)] <Insert value>, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section[s] "[033000 Cast-in-Place Concrete] [033053 Miscellaneous Cast-in-Place Concrete]."
- D. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils** (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 [**painting Sections**] [**Section 099600 "High-Performance Coatings"**] for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 PAYMENT

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

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

##### A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Innerduct
4. Metal wireways and auxiliary gutters.
5. Nonmetal wireways and auxiliary gutters.
6. Surface raceways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.
9. Buried conduits in concrete encased duct banks.

##### B. Related Requirements:

1. Division 26 Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Division 27 Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Division 28 Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.
4. Division 26 Section 260526 "Grounding and Bonding for Electrical Systems" for additional grounding and bonding requirements.

##### C. Prohibited Materials

1. Intermediate conduits.
2. Aluminum conduit.
3. Multi-conductor assemblies, unless written authorization is obtained from DEN Project Manager, or specifically allowed within specification.

##### D. Project Conditions

1. Verify locations of outlets and small pull-boxes prior to rough in.

2. Electrical and pull boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

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

### 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. RMC: Rigid Metallic Conduit.
- C. RNC: Rigid Nonmetallic Conduit.
- D. EMT: Electrical Metallic Conduit.
- E. FMC: Flexible Metallic Conduit.
- F. LFMC: Liquidtight Flexible Metallic Conduit.
- G. HDPE: High Density Polyethelene.
- H. FNC: Flexible Nonmetallic Conduit.
- I. ENT: Electrical non-metallic conduit.
- J. MC: Metal-clad cable.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals (if required):
  - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: Per request.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
- D. Source quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 CONSTRUCTION WASTE MANAGEMENT

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

## **PART 2 - PRODUCTS**

### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.

12. Wheatland Tube Company; a division of John Maneely Company.
  13. or approved equal.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
  2. Coating Thickness: 0.040 inch (1 mm), minimum.
- E. EMT: Galvanized tubing. Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Set screw or compression.
    - c. Provide throated connectors where entering junction boxes.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Innerduct:
1. Inner duct, meeting or exceeding the following requirements, shall be used to partition conduit.
    - a. Melting point: 260 degrees F., minimum.
    - b. Tensile yield strength: 3600 psi/sq. in., minimum
    - c. Brittleness temperature, maximum: -140 degrees F.
    - d. Heat distortion temperature: 170 degrees F minimum.
- J. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.
  3. Arnco Corporation.
  4. CANTEX Inc.
  5. CertainTeed Corp.
  6. Condux International, Inc.
  7. Electri-Flex Company.
  8. Kraloy.
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Niedax-Kleinhuis USA, Inc.
  11. RACO; a Hubbell company.
  12. Thomas & Betts Corporation.
  13. or approved equal.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. RTRC: Comply with UL 1684A and NEMA TC 14.
- H. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of

the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.
5. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
6. or approved equal.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R or Type 4x, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or screw cover.

E. Finish: Manufacturer's standard enamel finish.

## 2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

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

1. Allied Moulded Products, Inc.
2. Hoffman; a Pentair company.
3. Lamson & Sessions; Carlon Electrical Products.
4. Niedax-Kleinhuis USA, Inc.
5. or approved equal.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: Schedule 40 PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.



- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. **Manufacturer's standard enamel finish in color selected by the DEN Project Manager.**
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
    - d. or approved equal.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by DEN Project Manager from **manufacturer's standard** colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems Division.
    - b. Mono-Systems, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.
    - e. **<Insert manufacturer>**
    - f. or approved equal.

## 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.
  5. FSR Inc.
  6. Hoffman; a Pentair company.
  7. Hubbell Incorporated; Killark Division.
  8. Kraloy.
  9. Milbank Manufacturing Co.
  10. Mono-Systems, Inc.
  11. O-Z/Gedney; a brand of EGS Electrical Group.
  12. RACO; a Hubbell Company.
  13. Robroy Industries.
  14. Spring City Electrical Manufacturing Company.
  15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  16. Thomas & Betts Corporation.
  17. Wiremold / Legrand.
  18. <Insert manufacturer>
  19. or approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Galvanized steel. Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, **ferrous alloy**, Type FD, with gasketed cover. Provide threaded hubs.
- E. Nonmetallic Outlet and Device Boxes: Prohibited, unless specifically allowed in writing by the DEN Project Manager.
- F. Metal Floor Boxes:
1. Material: **Cast metal**.
  2. Type: Fully adjustable.
  3. Shape: [Rectangular] **[round]** <Insert shape>.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Prohibited, unless specifically allowed by the DEN Project Manager.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing **50 lb (23 kg)**. Outlet boxes designed for attachment of luminaires weighing more than **50 lb (23 kg)** shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan

weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: Galvanized steel. NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, **galvanized, cast iron** with gasketed cover.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) or as approved by DEN Project Manager.
- N. Gangable boxes are allowed.
- O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R or Type 4x as appropriate, with continuous-hinge cover with flush latch unless otherwise indicated. Screw cover enclosures: VL50 & NEMA 1.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Plastic or Fiberglass.
  3. Interior Panels: Steel; 14 gage steel, 12 gage if floor mounted, all sides finished with manufacturer's standard enamel, white.
  4. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
    - a. Interior Dry Locations: Use hinged or screw covered enclosure.
    - b. Interior damp or wet locations: Use nema 3R hinged cover boxes.
- P. Cabinets:
1. NEMA 250, **[Type 1] [Type 3R] [Type 12]** <Insert type> galvanized-steel box with removable interior panel and removable **[front][end walls]**, finished inside and out with manufacturer's standard enamel, gray.
  2. Cabinet Fronts: Steel, flush or surface type as indicated, with concealed trim clamps, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray baked enamel.
  3. Provide 3/4-inch thick fire retardant plywood backboard or galvanized steel back plate painted matte white, for mounting terminal blocks.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.
  6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  7. Fabrication:

- a. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- b. Provide knockouts on enclosures.
- c. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

Q. Terminal blocks and accessories:

1. All terminal Blocks: ANSI/NEMA ICS 4; UL listed.
2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw terminals, rated 600 volts.
3. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw terminals, rated 300 volts.
4. Power and signal/control wiring will use separate terminal blocks.

## 2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete or stainless steel Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. CDR Systems Corporation; Hubbell Power Systems.
  - d. NewBasis.
  - e. Oldcastle Precast, Inc.; Christy Concrete Products.
  - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - g. or approved equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with **[open] [closed] [integral closed]** bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, [**ELECTRIC.**] **<Insert legend>**.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes [12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)] <Insert dimensions> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. CDR Systems Corporation; Hubbell Power Systems.
  - d. NewBasis.
  - e. Nordic Fiberglass, Inc.
  - f. Oldcastle Precast, Inc.; Christy Concrete Products.
  - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - h. or approved equal.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: [Gray] [Green].
4. Configuration: Designed for flush burial with [open] [closed] [integral closed] bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, ["ELECTRIC."] <Insert legend>.
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes [12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)] <Insert dimensions> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Raceways shall not be installed in stairways or on the exterior of any building, unless specifically allowed by DEN Project Manager.
- B. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: RMC.
  2. Concealed Conduit, Aboveground: RMC.
  3. Underground Conduit: Encased in concrete per Section 260543, "Underground Ducts and Raceways for Electrical Systems."
    - a. Direct buried conduits are not allowed unless specifically allowed by the DEN Project Manager.
  4. Exposed Conduit in Parking Garages or other covered structures open to environment:
    - a. Below 8'-0" AFF or within 10'-0" of extent of covered area: Galvanized RMC.
    - b. Above 8'-0" AFF and more than 10'-0" from extent of covered area: EMT with compression-type weatherproof/rain-tight connectors.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R Type 4.
- C. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: GRC . Raceway locations include the following:
    - a. Loading dock.
    - b. Baggage tunnels
    - c. **<Insert designations of applicable spaces or locations>**
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- D. CONDUIT INSTALLATION SCHEDULE

1. Underground Installations More Than Five Feet From Foundation Wall: Polyvinyl Chloride (PVC) conduit Schedule 40. All bends greater than 45 degrees in non-metallic conduit shall be galvanized rigid steel conduit with a factory coating of polyvinyl chloride (PVC).
  2. Installation In Concrete Slab: Not allowed.
    - a. All buried conduits containing cabling shall be installed in concrete encased duct banks.
  3. In Slab Above Grade: Not allowed.
  4. Wet Interior Locations: Rigid steel.
  5. Concealed Dry Interior Locations: Electrical metallic tubing.
  6. In Existing Walls of Existing Structure: Electrical metallic tubing or MC Cable.
- E. Minimum Raceway Size: [1/2-inch (16-mm)] [3/4-inch (19-mm)] trade size.
- F. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew, or compression, steel fittings. Comply with NEMA FB 2.10.
    - a. Setscrew fittings to be used for indoor applications in dry locations only.
    - b. Compression fittings may be used in indoor or outdoor locations for damp or wet locations.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).
- I. Unless otherwise indicated and where not otherwise restricted, use the conduit type indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use Galvanized Rigid Conduit.
- ### 3.2 INSTALLATION
- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. Maintain a minimum of **6 inches (150 mm)** between conduit and other piping. Maintain twelve inches (12" ) clearance between conduit and a heat source such as heating pipes, exhaust flues and heating appliances. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within **24 inches (610 mm)** of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines. Use conduit bodies to make changes in direction around beams or columns.
- H. Support conduit within **24 inches (610 mm)** of enclosures to which attached. Support conduit at a maximum of 8 feet on center, within two (2) feet of a box or fitting.
- I. Use only factory cast hubs for fastening conduit to cast boxes, and use steel or malleable iron hubs for fastening conduit to sheet metal boxes or equipment in damp or wet locations.
- J. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- K. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture during construction.
- L. Use PVC-coated rigid steel factory elbows for bends greater than 45 degrees in plastic conduit runs.
- M. Exposed conduits subject to physical damage to be rigid steel to 6'-0" above floor, deck or grating except in electrical, communications and mechanical rooms.
- N. Conduit stubbed up shall be two inches above slab or housekeeping pad and the empty conduits shall be capped. Under freestanding equipment conduits with conductors shall be sealed with duct seal.
- O. Flexible steel conduit runs shall not exceed 6' in length when connecting equipment, 6' in length when connecting light fixtures or when fished in hollow spaces with written approval by DEN Project Manager and shall contain a grounding conductor.
- P. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in



hubs or in an enclosure.

- Q. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- R. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- S. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- T. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch (35mm)** trade size and insulated throat metal bushings on **1-1/2-inch (41-mm)** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- U. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- V. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- W. Cut conduit perpendicular to the length. For conduits **2-inch (53-mm)** trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- X. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **160-lb (72-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Y. Surface Raceways:
1. Install surface raceway with a minimum **2-inch (50-mm)** radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- Z. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- AA. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- BB. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- CC. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F (17 deg C)** and that has straight-run length that exceeds **25 feet (7.6 m)**. Install in each run of aboveground RMC **and EMT** conduit that is located where environmental temperature change may exceed **100 deg F (55 deg C)** and that has straight-run length that exceeds **100 feet (30 m)**.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F (70 deg C)** temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F (86 deg C)** temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F (70 deg C)** temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C)** of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least **0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C)** of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
  6. Provide external bonding jumper for all expansion fittings..
- DD. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of **72 inches (1830 mm)** of flexible conduit for **recessed and semirecessed luminaires**, equipment subject to vibration, noise transmission, or movement; and for transformers and motors. All vibrating equipment such as motors, transformers, and generators shall be connected with flexible steel conduit, not to exceed six feet in length.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- EE. Size conduit for conductor type installed or for Type THHN conductors, whichever is

- larger.
- FF. Arrange conduit to maintain headroom and present a neat appearance. Certain existing conditions may allow a waiver to this item.
- GG. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- HH. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- II. Do not support conduit from cable tray or cable tray supports.
- JJ. Flexible conduit shall not be less than one-half (1/2) inch except when supplied with lighting fixtures. MC Cable shall be allowed in lieu of flexible conduit for light fixtures in lengths of 6 feet or less.
- KK. When anchoring to a dual sheet metal pan deck and concrete, anchors of any type when placed from below the deck shall be placed only in the lower pan form. No anchors shall be installed in the upper (high) pan.
- LL. X-ray [or ground penetrating radar] studies shall be made of concrete floors, walls or CMU walls.
- MM. Mount boxes at heights indicated on Drawings. Install boxes with height measured to **center** of box unless otherwise indicated. Coordinate mounting heights and locations of boxes or outlets so as not to be interfered with by grounding systems, electrical panels, or any other building accessory.
- NN. Coordinate installation of outlet or equipment boxes for systems or products furnished under other sections.
- OO. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- PP. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Provide minimum 8 inch separation.
- QQ. Locate boxes so that cover or plate will not span different building finishes.
- RR. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- SS. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- TT. Set metal floor boxes level and flush with finished floor surface.

- UU. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
  - VV. Install electrical boxes as shown on Drawings, and as required for equipment, terminal strips, splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
  - WW. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed light fixture.
  - XX. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
  - YY. Use adjustable steel channel fasteners or all thread for hanging ceiling outlet box, support box from structure.
  - ZZ. Support boxes in the ceiling with ¼" threaded rod as a minimum.
  - AAA. Use appropriate gang box where more than one device is mounted together.
  - BBB. Use 4 inch square box with plaster ring for single device outlets.
  - CCC. Use malleable iron outlet box when surface mounted: on exterior of building, in wet location or damp location.
  - DDD. Minimum junction and pull box size 4-11/16" x 4-11/16" x 2-1/8" .
  - EEE. Minimum outlet box size 4" x 4" x 2-1/8" including feed through outlet boxes.
  - FFF. Minimum junction box size for fire alarm pull stations, control module, monitor module, 4" x 4" x 2-1/8". Provide plaster ring at all pull station locations.
  - GGG. Use flush mounting outlet boxes in finished areas.
  - HHH. Install knockout closure in unused box openings.
  - III. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
  - JJJ. All floor-mounted equipment shall be on a 4" nominal concrete housekeeping pad.
  - KKK. No cabinet shall be supported on slab or grade.
- 3.3 INSTALLATION OF UNDERGROUND CONDUIT
- A. Refer to Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for underground conduit installation requirements.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Refer to Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for underground handhole and box installation requirements

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**PART 4 - MEASUREMENT**

4.1 METHOD OF MEASUREMENT

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

**PART 5 - PAYMENT**

5.1 PAYMENT

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

END OF SECTION 260533

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Section, apply to this Section.
- B. Related Specification Sections:
  - 1. Section 017515 – “System Startup, Testing and Training,” for startup, testing and training procedures.
  - 2. Section 017900 – “Demonstration and Training,” for demonstration and training content and requirements.
  - 3. Section 019113 - “General Commissioning Requirements,” for general commissioning procedures, definitions and requirements.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. General commissioning requirements for electrical systems.
- B. Equipment-specific commissioning requirements are contained in each Section for the related equipment.

#### 1.3 DEFINITIONS

- A. Commissioning Authority (CA or CxA): The Party retained by DEN who will oversee the Commissioning process as well as develop and stipulate many of the Commissioning requirements. They will also manage the Commissioning process, and ensure and validate that systems and equipment are designed, installed, and tested to meet DEN’s requirements.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. Contractor: As used herein, ‘Contractor’ is a general reference to the installing Party and can therefore refer to the General Contractor, subcontractors, or vendors as inferred by its usage.
- D. Pre-Start Up: Preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.

- E. Start-Up: Refers to the quality control process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing, including Start-Up Tests.

#### 1.4 RESPONSIBILITY

- A. Refer to Section 019113 "General Commissioning Requirements" for general responsibilities of the CxA and the Contractor.
- B. Division 26 (electrical) contractor's commissioning responsibilities shall include:
  - 1. All inspection and manipulation of live electrical equipment as required to perform commissioning activities.
  - 2. Coordination of electrical shutdowns as required to perform commissioning activities. All electrical shutdowns must be submitted in writing to the DEN Project Manager not less than (5) days prior to the scheduled shutdown.
- C. CxA's responsibilities electrical commissioning responsibilities shall include:
  - 1. Collect and organize results of all pre-startup, startup, and functional performance testing performed by CxA and Contractor, including all testing set forth in Division 26. Test results shall be included in the commissioning report.
  - 2. Document issues in the Issues Log.

#### 1.5 SYSTEMS TO BE COMMISSIONED

- A. Electrical Systems:
  - 1. Automatic transfer switches.
  - 2. Emergency power distribution.
  - 3. Engine generators for **[emergency] [and] [standby]** power.
  - 4. Ground fault **[protection] [and] [detection]**.
  - 5. Lighting controls.
  - 6. Power factor correction.
  - 7. Protective device selective coordination.
  - 8. Surge protection devices.
  - 9. UPS systems.
- B. Life Safety Systems:
  - 1. Emergency communications system.
  - 2. Fire alarm system.

#### 1.6 COORDINATION

- A. Electrical commissioning activities shall comply with all applicable safety standards,

rules and regulations, including but not limited to:

1. DEN Airport Safety Policy.
  2. ROCIP safety requirements.
  3. Contractor's approved site-specific safety plan.
  4. NFPA 70E, current edition.
- B. Refer to Section 011400 "Work Sequence and Constraints" for general work sequencing and coordination requirements.
- C. CxA and Contractor shall coordinate all commissioning-related activities as directed by the DEN Project Manager.

#### 1.7 ACTION SUBMITTALS

- A. Comply with the requirements of Section 013300 "Submittal Procedures."
- B. CxA submittals:
1. Include information pertaining to Division 26 equipment for all commissioning submittals required in accordance with Section 019113 "General Commissioning Requirements."
  2. Electrical commissioning activity matrix:
    - a. CxA shall review the Division 26 specifications and ensure that all required equipment commissioning activities are addressed in the commissioning plan.
    - b. Commissioning plan shall include an activity matrix, showing all required commissioning activities associated with Division 26, including CxA and Contractor activities, including but not limited to submittal reviews, installation observation, pre-startup, startup, functional testing, acceptance testing, training, deferred testing, and warranty walkthrough. CxA shall ensure the commissioning activity matrix is inclusive of all testing described in the Contractor's electrical testing plan. Matrix shall include:
      - 1) Activity name.
      - 2) Description.
      - 3) Responsibility matrix (showing responsible, accountable, consulted, and informed parties for each activity).
      - 4) Anticipated start date.
      - 5) Anticipated end date.
- C. Contractor submittals:
1. Comply with the requirements of Section 019113 "General Commissioning Requirements" for all Division 26 equipment to be commissioned.
  2. Contractor's electrical testing plan, including:
    - a. Equipment to be tested.
    - b. Operating modes to be tested, for each equipment type.



- c. Dates of testing.
  - d. Responsible parties.
3. Test procedures: Submit for each equipment type. Procedures shall be formatted for use in equipment testing and shall include:
  - a. Responsible subcontractor.
  - b. A list of integral components being inspected or tested.
  - c. Test equipment used.
  - d. Associated checklists, if any.
  - e. Special required conditions, if any.
  - f. Items, conditions or functions to be inspected, verified, or tested, and the testing method to be used.
  - g. Acceptance criteria.
  - h. Sampling strategy, if any.
  - i. Space for recording of equipment information.
  - j. Space for recording all test results after each prescribed test.
4. Test Results: Submit for each piece of tagged equipment. Results shall utilize the accepted test procedures form and shall include:
  - a. Tagged equipment name/number. If equipment is untagged, include location and any additional information as needed to positively identify the equipment.
  - b. Manufacturer and model number.
  - c. Performance information and rating data.

## **PART 2 - PRODUCTS (not used)**

## **PART 3 - EXECUTION**

### **3.1 SUBMITTALS**

- A. CxA shall submit electrical commissioning activity matrix not less than (30) days prior to start of first planned activity.
- B. Not less than (60) days before any onsite testing activities are conducted, Contractor shall submit an overall electrical testing plan and schedule for electrical systems as described in Part 1. Testing activities shall be included in the construction schedule.
- C. CxA shall review Contractor's electrical testing plan and revise commissioning activity matrix to include all activities as described in Contractor's testing plan.
- D. Contractor shall submit test procedures for each type of equipment not less than (14) days prior to start of testing of that equipment type.
- E. Contractor shall submit test results not more than (14) days following completion of associated testing, or as directed by the DEN Project Manager.

### 3.2 TESTING

- A. Contractor shall perform pre-testing of all equipment to verify proper operation.
- B. Refer to Section 019113 "General Commissioning Requirements" for test sampling and procedures related to nonconforming work.
- C. Test procedures for dynamic equipment:
  - 1. Dynamic electrical equipment is equipment which includes multiple operating modes, responses and/or sequences, and shall include but is not limited to the following:
    - a. Scheduled, occupancy-based or daylight-responsive lighting controls.
    - b. Emergency and standby generators.
    - c. UPS systems.
    - d. Fire Alarm systems.
  - 2. Test procedures for dynamic equipment shall be written as step-by-step testing instructions, including expected responses and sample results.
- D. Test procedures for static equipment:
  - 1. Static equipment includes electrical equipment designed for static operation and shall include but is not limited to the following:
    - a. Panel boards.
    - b. Switchgear.
    - c. Transformers.
    - d. Circuit breakers and safety switches.
  - 2. Test procedures for static equipment may be written in a checklist format, as appropriate for the equipment.
- E. Refer to individual Sections contained in Division 26 for equipment-specific testing requirements.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

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

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

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

END OF SECTION 260800

## SECTION 261200 – MEDIUM-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following types of transformers with medium-voltage primaries:
  - 1. Liquid-filled distribution and power transformers.
  - 2. Dry-type distribution and power transformers.
  - 3. Pad-mounted, liquid-filled transformers.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. NETA ATS: Acceptance Testing Specification.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, K-FACTOR and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.
- C. Shop Drawings: Diagram power **[signal]** **[and]** **[control]** wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items

involved:

1. Underground [**primary**] [**secondary**] [**primary and secondary**] conduit stub-up location.
2. Dimensioned concrete base, outline of transformer, and required clearances.
3. Ground rod and grounding cable locations.
4. **<Insert details.>**

B. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Follow-up service reports.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

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

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing

laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2.
- E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.
- F. Comply with NFPA 70.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store transformers [**protected from weather and**] so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather

#### 1.9 PROJECT CONDITIONS

- A. Service Conditions: IEEE C37.121, usual service conditions except for the following:
  1. Exposure to significant solar radiation.
  2. Altitude: **5,500 feet** (1677 m)
  3. Ambient temperature range **-30 deg F** (-35 deg C) to **120 deg F** (49 deg C)
  4. Exposure to fumes, vapors, or dust.
  5. Exposure to explosive environments.
  6. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
  7. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
  8. Exposure to excessively high or low temperatures.
  9. Unusual transportation or storage conditions.
  10. Unusual grounding-resistance conditions.
  11. Unusual space limitations.
  12. Exposure to Deicing chemicals.
- B. Power Outages:

1. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown.

#### 1.10 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

#### 1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
  1. Acme Electric Corporation; Power Distribution Products Division.
  2. Cooper Industries; Cooper Power Systems Division.
  3. Cutler-Hammer.
  4. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
  5. GE Electrical Distribution & Control.
  6. Hammond Manufacturing; Transformer Group.
  7. Kuhlman Electric Corporation.
  8. Pauwels Transformers.
  9. Pioneer Transformers.
  10. Siemens Energy & Automation, Inc.
  11. Square D; Schneider Electric.
  12. Uptegraff, R. E. Mfg. Co.
  13. Virginia Transformer Corp.
  14. Sorgel.
  15. Sola/Hevi-Duty.
  16. <Insert manufacturer>
  17. or approved equal.

#### 2.2 LIQUID-FILLED DISTRIBUTION AND POWER TRANSFORMERS

- A. Description: IEEE C57.12.00 and UL 1062, liquid-filled, 2-winding transformers.
- B. Insulating Liquid: Mineral oil, complying with ASTM D 3487, Type II, and tested according to ASTM D 117.
- C. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Insulating Liquid: Less flammable, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- E. Insulating Liquid: Less flammable, silicone-based dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall have low toxicity and be nonhazardous.
- F. Insulation Temperature Rise: 65/55 deg C, based on an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C. Insulation system shall be rated to continuously allow an additional 12 percent kilovolt-ampere output, at 65 deg C temperature rise, without decreasing rated transformer life.
- G. Insulation Temperature Rise: 65 deg C, based on an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C.
- H. Basic Impulse Level: Comply with UL 1062.
- I. Basic Impulse Level: **[60] [75] [95] [110]** kV.
- J. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- K. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps below rated primary voltage, with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- L. Cooling System: Class **[OA, self-cooled] [OA/FA, self-cooled, and with forced-air-cooled rating] [OA/FFA, self-cooled, and with provisions for future forced-air-cooled rating]**. Cooling systems shall include auxiliary cooling equipment, automatic controls, and status indicating lights.
- M. Sound level may not exceed **[sound levels listed in NEMA TR 1] <Insert acceptable dBA level>**, without fans operating.
  - 1. Maximum guaranteed sound levels are as follows:

| <b>KVA Rating:</b> | <b>Sound Level:</b> |
|--------------------|---------------------|
| 1-5                | 30dB                |



| <b>KVA Rating:</b> | <b>Sound Level:</b> |
|--------------------|---------------------|
| 6-25               | 40 dB               |
| 26-150             | 42 dB               |
| 151-225            | 43 dB               |
| 226-300            | 47dB                |
| 301-500            | 51dB                |

- N. Impedance: <Insert value> percent.
- O. Accessories: Grounding pads, lifting lugs, and provisions for jacking under base. Transformers shall have a steel base and frame allowing use of pipe rollers in any direction, and an insulated, low-voltage, neutral bushing with removable ground strap. Include the following additional accessories:
1. Liquid-level gage.
  2. Pressure-vacuum gage.
  3. Liquid temperature indicator.
  4. Drain and filter valves.
  5. Pressure relief device.

### 2.3 DRY-TYPE DISTRIBUTION AND POWER TRANSFORMERS

- A. Description: NEMA ST 20, IEEE C57.12.01, [ANSI C57.12.50] [ANSI C57.12.51] [ANSI C57.12.52], [UL 1562 listed and labeled], dry-type, 2-winding transformers.
1. [Indoor, ventilated] [Outdoor, ventilated] [Totally enclosed, nonventilated], cast coil/encapsulated coil, with primary and secondary windings individually cast in epoxy; with insulation system rated at 185 deg C with an 80 deg C average winding temperature rise above a maximum ambient temperature of 40 deg C.
  2. [Indoor, ventilated] [Outdoor, ventilated] [Totally enclosed, nonventilated], vacuum-pressure impregnated and with insulation system rated at 220 deg C with an 80 deg C average winding temperature rise above a maximum ambient temperature of 40 deg C.
  3. All transformer windings shall be copper.
- B. Enclosure top temperature shall not exceed 35 deg C rise above 40 deg C ambient at its warmest point.
- C. Primary Connection: Air terminal compartment with [removable] [hinged] door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.
- D. Primary Connection: Transition terminal compartment with connection pattern to match switchgear.
- E. Secondary Connection: Air terminal compartment with [removable] [hinged] door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.

- F. Secondary Connection: Transition terminal compartment with connection pattern to match **[switchgear] [bus duct] <Insert connection pattern>**.
- G. Insulation Materials: IEEE C57.12.01, rated at 220 deg C.
- H. Insulation Temperature Rise: **[80] [115] [150]** deg C, maximum rise above 40 deg C.
- I. Basic Impulse Level: **[10] [60] [75] [95] [110]** kV.
- J. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage.
- K. Cooling System: Class **[AA, self-cooled] [AA/FA, self-cooled, and with forced-air-cooled rating] [AA/FFA, self-cooled, and with provisions for future forced-air-cooled rating]**, complying with IEEE C57.12.01.
  - 1. Automatic forced-air cooling system controls, including thermal sensors, fans, control wiring, temperature controller with test switch, power panel with current-limiting fuses, indicating lights, alarm, and alarm silencing relay.
  - 2. Include mounting provision for fans.
  - 3. Transformer cooling fans, when required shall be of the sealed bearing type.
- L. Sound level may not exceed **<Insert acceptable dBA level> [sound levels listed in NEMA TR 1]**, without fans operating.

- 1. Maximum guaranteed sound levels are as follows:

| <b>KVA Rating:</b> | <b>Sound Level:</b> |
|--------------------|---------------------|
| 1-5                | 30dB                |
| 6-25               | 40 dB               |
| 26-150             | 42 dB               |
| 151-225            | 43 dB               |
| 226-300            | 47dB                |
| 301-500            | 51dB                |

- M. Impedance: **<Insert value>** percent.
- N. High-Temperature Alarm: Sensor at transformer with local audible and visual alarm and contacts for remote alarm.
- O. Ground core and coil assembly to enclosure by means of a visible flexible copper-grounding strap.
- P. Mounting: Transformers 30 KVA and larger shall be, floor mounted; Transformers less than 30 KVA shall be designed for either floor or wall mount.
- Q. Isolate transformer-winding assemblies from enclosure using vibration-absorbing mounts.

## 2.4 DRY TYPE TRANSFORMERS FOR NON-LINEAR LOAD

- A. In addition to the requirements of paragraph 2.02, transformers for non-linear loads shall be three phase, 60 Hertz, with delta connected primary and wye connected secondary windings.
- B. Copper electrostatic shielding shall be inserted between the primary and secondary windings.
- C. The primary winding conductors shall be of sufficient size to limit the temperature rise to its rated value even with the circulating third harmonic current.
- D. The secondary neutral shall be twice the ampacity of the secondary phase conductors.

## 2.5 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

- A. Description: ANSI C57.12.13, **[ANSI C57.12.26]**, IEEE C57.12.00, **[IEEE C57.12.22]**, pad-mounted, 2-winding transformers. Stainless-steel tank base **[and cabinet] [, cabinet, and sills]**.
- B. Insulating Liquid: Mineral oil, complying with ASTM D 3487, Type II, and tested according to ASTM D 117.
- C. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Insulating Liquid: Less flammable, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- E. Insulating Liquid: Less flammable, silicone-based dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall have low toxicity and be nonhazardous.
- F. Insulation Temperature Rise: **[55] [65]** deg C when operated at rated kVA output in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.
- G. Basic Impulse Level: **[30] [60] [95]** kV.
- H. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- I. High-Voltage Switch: **[200] [300] [400]** A, make-and-latch rating of 10-kA RMS, symmetrical, arranged for radial feed with 3-phase, 2-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.

- J. High-Voltage Switch: **[200] [300] [400]** A, make-and-latch rating of 10-kA RMS, symmetrical, arranged for loop feed with 3-phase, 4-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.
- K. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47. **[ Rating of current-limiting fuses shall be 50-kA RMS at specified system voltage.]**
1. Current-limiting type in dry-fuse holder wells, mechanically interlocked with liquid-immersed switch in transformer tank to prevent disconnect under load.
  2. Internal liquid-immersed cartridge fuses.
  3. Bay-O-Net liquid-immersed fuses that are externally replaceable without opening transformer tank.
  4. Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses. Bay-O-Net fuses shall be externally replaceable without opening transformer tank.
  5. Bay-O-Net liquid-immersed current-limiting fuses that are externally replaceable without opening transformer tank.
- L. Surge Arresters: Distribution class, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1; support from tank wall within high-voltage compartment. Transformers shall have **[three arresters for radial-feed] [three arresters for loop-feed] [six arresters for loop-feed]** circuits.
- M. High-Voltage Terminations and Equipment: Live front with externally clamped porcelain bushings and cable connectors suitable for terminating primary cable.
- N. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:
1. Bushing-Well Inserts: One for each high-voltage bushing well.
  2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
  3. Parking Stands: One for each high-voltage bushing well.
  4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.
- O. Accessories:
1. Drain Valve: **1 inch (25 mm)**, with sampling device.
  2. Dial-type thermometer.
  3. Liquid-level gage.
  4. Pressure-vacuum gage.
  5. Pressure Relief Device: Self-sealing with an indicator.
  6. Mounting provisions for low-voltage current transformers.
  7. Mounting provisions for low-voltage potential transformers.
  8. Busway terminal connection at low-voltage compartment.
  9. Alarm contacts for gages and thermometer listed above.

## 2.6 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
1. Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to [ANSI C57.12.50] [ANSI C57.12.51] [IEEE C57.12.90] [IEEE C57.12.91].
- B. Factory Tests: Perform the following factory-certified tests on each transformer:
1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
  2. Ratios on rated-voltage connection and on tap extreme connections.
  3. Polarity and phase relation on rated-voltage connection.
  4. No-load loss at rated voltage on rated-voltage connection.
  5. Excitation current at rated voltage on rated-voltage connection.
  6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
  7. Applied potential.
  8. Induced potential.
  9. Temperature Test: If transformer is supplied with auxiliary cooling equipment to provide more than one rating, test at lowest kilovolt-ampere Class OA or Class AA rating and highest kilovolt-ampere Class OA/FA or Class AA/FA rating.
    - a. Temperature test is not required if record of temperature test on an essentially duplicate unit is available.
  10. Owner will witness all required factory tests. Notify DEN Project Manager at least fourteen (14) days before date of tests and indicate their approximate duration.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.
- B. Examine roughing-in of conduits and grounding systems to verify the following:
1. Wiring entries comply with layout requirements.
  2. Entries are within conduit-entry tolerances specified by manufacturer and no

feeders will have to cross section barriers to reach load or line lugs.

- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Transformers 30 KVA and larger shall be floor mounted. Transformers less than 30KVA shall be floor or wall mounted.
- B. Install transformers on concrete bases.
  - 1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 2. Set transformer plumb and level.
  - 3. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and 4 inches (100 mm) high.
  - 4. Use [3000-psi (20.7-MPa)] <Insert other>, 28-day compressive-strength concrete and reinforcement as specified in Section[s] [033000 "Cast-in-Place Concrete"] [033053 "Miscellaneous Cast-in-Place Concrete"].
  - 5. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 6. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
  - 7. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 8. Tack-weld or bolt transformers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Use flexible conduit, 3 feet maximum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- F. Use a copper busbar bolted to the transformer case to bond XO, Primary feeder

grounding conductor, secondary grounding conductor, and grounding electrode conductor with copper conductor sized according to table 250-66 in the NEC.

### 3.3 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in Section 260553 "Identification for Electrical Systems."

### 3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, **test, and adjust**] field-assembled components and equipment installation, including connections[, **and to assist in field testing**]. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
  - 2. Check for damage and tighten connections prior to energizing transformer. Submit torque values and check list to the DEN Project Manager. .
  - 3. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
  - 4. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
  - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 6. Remove and replace malfunctioning units and retest as specified above.
- C. Test Reports: Prepare written reports to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

### 3.6 FOLLOW-UP SERVICE

- A. Voltage Monitoring and Adjusting: If requested by Owner, perform the following voltage monitoring after Substantial Completion but not more than six (6) months after Final

Acceptance:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch (25 mm) per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
  2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:
    - a. Adjust transformer taps.
    - b. Prepare written request for voltage adjustment by electric utility.
  3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
  4. Report: Prepare written report covering monitoring and corrective actions performed.
- B. Infrared Scanning: Perform as specified in Section 261300 "Medium-Voltage Switchgear."

#### **PART 4 - MEASUREMENT**

##### **4.1 METHOD OF MEASUREMENT**

- A. No separate measurement shall be made for work under this Section.

#### **PART 5 - PAYMENT**

##### **5.1 METHOD OF PAYMENT**

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 261200



## SECTION 261300 - MEDIUM-VOLTAGE SWITCHGEAR

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes metal-clad, circuit-breaker switchgear with the following optional components, features, and accessories:
  - 1. **[Copper, silver-plated main bus at connection points] [Copper, tin-plated main bus].**
  - 2. Communication modules.
  - 3. Provisions for future devices.
  - 4. Control battery system.
  - 5. Mimic bus.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. GFCI: Ground-Fault Circuit Interrupter.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchgear and related equipment, include the following:
  - 1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual circuit breakers.
  - 2. Time-current characteristic curves for overcurrent protective devices, including circuit-breaker relay trip devices.
  - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each type of switchgear and related equipment, include the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
    - a. Tabulation of installed devices with features and ratings.
    - b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
    - c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
    - d. Floor plan drawing showing locations for anchor bolts [**and leveling channels**].
    - e. Current ratings of buses.
    - f. Short-time and short-circuit ratings of switchgear assembly.
    - g. Nameplate legends.
    - h. Mimic-bus diagram.
    - i. Utility company's metering provisions with indication of approval by utility company.
  2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting seismic restraints.
  3. Wiring Diagrams: For each type of switchgear and related equipment, include the following:
    - a. Power, signal, and control wiring.
    - b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
    - c. Schematic control diagrams.
    - d. Diagrams showing connections of component devices and equipment.
    - e. Schematic diagrams showing connections to remote devices[ including SCADA remote terminal unit].
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.
- D. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For installer and product manufacturers.
  - B. Source quality-control test reports.
  - C. Field quality-control test reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.7 QUALITY ASSURANCE

- A. Factory Testing and Witness Testing:
1. Furnish all test equipment and personnel, and perform all tests as may be required and as specified herein.
  2. The manufacturer shall perform all tests normally conducted in accordance with the manufacturer's standard test procedures for all substations. In addition, the manufacturer shall perform all supplementary testing as defined throughout this specification for all substations. All normal and supplemental testing, which is not witnessed by the DEN Project Manager, shall be documented in certified test reports and shall be submitted to the DEN Project Manager for review within two weeks of the performance of the testing.
  3. The following tests shall be performed at the factory and shall be witnessed by the Engineer of Record and DEN Project Manager, or their duly authorized representative:
    - a. A complete visual inspection of the equipment, both internally and externally.
    - b. A complete test of all automatic transfer schemes including all operation and failure modes.
    - c. A complete test of all control panels and controls including dry contact outputs.
    - d. Verification of proper operation of all metering.
    - e. Verify mechanical operation; interlocks and interchangeability of selected breakers.
  4. The testing outlined in item "A" above shall be performed only on one main switchgear. In order to perform such testing, all breakers shall be shipped to the switchboard factory and installed in their respective cubicles in a completely assembled Distribution Section
  5. Test 208 volt and /or 480 volt, 3-phase power sources shall be connected to the incoming side of each secondary main such that the sources may be individually applied and removed to completely simulate and test all features of the

- distribution sections.
6. Submit to the DEN Project Manager ninety (90) calendar days prior to scheduled testing all test procedures for approval, and notify the DEN Project Manager four (4) weeks prior to scheduled testing what the expected duration of the tests will be.
  7. Provide four (4) copies of the factory test report within two (2) weeks of the completion of such witness tests.
- B. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C2.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.
  - B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
  - C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.
  - D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:
    1. Ambient temperature range: -30 deg F (-35 deg C) to 120 deg F (49 deg C)
    2. Altitude: 5500 feet (1677 m) above sea level.
    3. Excessive solar radiation.
    4. **<Insert unusual service conditions.>**

- B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown.
  - 2. Do not proceed with interruption of electrical service without DEN Project Manager's written permission.

#### 1.10 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

#### 1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: **[Six (6)] <Insert number>** of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
  - 2. Indicating Lights: **[Six (6)] <Insert number>** of each type installed.
  - 3. Touchup Paint: **[Three (3)] <Insert number>** containers of paint matching enclosure finish, each **0.5 pint** (250 mL).
- B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:
  - 1. Fuse-handling tool.
  - 2. Extension rails, lifting device, transport or dockable dolly or mobile lift, and all other items necessary to remove circuit breaker from housing and transport to remote location.

3. Racking handle to move circuit breaker manually between connected and disconnected positions, and a secondary test coupler to permit testing of circuit breaker without removal from switchgear.

## 1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
    - a. **<Insert manufacturer>**
    - b. or approved equal.

### 2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.
- B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system.
- C. System Voltage: **[4.16 kV nominal; 4.76 kV maximum] [7.2 kV nominal; 15 kV maximum] [13.8 kV nominal; 15 kV maximum] [34.5 kV nominal; 38 kV maximum] <Insert other voltage>**.

### 2.3 METAL-CLAD, CIRCUIT-BREAKER SWITCHGEAR

- A. Subject to compliance with requirements, provide products by one of the following:
  1. ABB Control, Inc.
  2. Eaton Corporation; Cutler-Hammer Products.
  3. General Electric Distribution & Control.
  4. Siemens Energy & Automation, Inc.
  5. Square D; Schneider Electric.
  6. **<Insert manufacturer>**
  7. or approved equal.
- B. Comply with IEEE C37.20.3.

- C. Comply with IEEE C37.20.7. Provide arc-resistant switchgear, Type [1] [2] [1C] [2C].
- D. Nominal Interrupting-Capacity Class: [250] [350] [500] [750] [1000] MVA.
- E. Ratings: Comply with IEEE C37.04.
- F. Circuit Breakers: Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, [vacuum-sealed] [sulfur hexafluoride insulated and sealed] interrupter modules and including the following features:
  - 1. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated.
    - a. Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment.
      - 1) Control Power: [48] [125] <Insert voltage>-V dc for closing and tripping.
- G. Test Accessories: Relay and meter test plugs.
- H. Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.
- I. Grounding and Testing Device: Suitable for phasing out, testing, and grounding switchgear bus or feeder if device is installed in place of circuit breaker. Include the following:
  - 1. Portable Grounding and Testing Device: Interchangeable with drawout-mounting, medium-voltage circuit breakers to provide interlocked electrical access to either bus or feeder; electrically operated.
  - 2. System control cabinet permanently mounted near switchgear.
  - 3. Portable Remote-Control Station: For grounding and testing device.
  - 4. Control-Cabinet Coupler Cable: Of adequate length to connect device inserted in any switchgear cubicle and control cabinet.
  - 5. Remote-Control Coupler Cable: 50 feet (15 m) long to connect control cabinet and portable remote-control station.
  - 6. Permanent Control Power Wiring: From control cabinet to power source.
  - 7. Protective Cover: Fabricated of heavy-duty plastic and fitted to device.
  - 8. Approval of Grounding and Testing Device System: Obtain approval of final system design from utility company and agency designated by Owner to handle future maintenance of medium-voltage switchgear.
- J. Circuit-Breaker Test Cabinet: Separately mounted and containing push buttons for circuit-breaker closing and tripping, control relay, fuses, and secondary coupler with cable approximately 108 inches (2740 mm) long. Include a set of secondary devices for operating circuit breaker if removed from switchgear and moved near test cabinet. Include provision for storage of test and maintenance accessories in cabinet.

- K. Remote-Tripping Device: Wall-mounting emergency control station to open circuit breakers; located in red cast-metal box with break-glass operation.

## 2.4 FABRICATION

- A. Indoor Enclosure: Steel.
- B. Outdoor Enclosure: Galvanized steel, weatherproof construction; integral structural-steel base frame with factory-applied asphaltic undercoating.
1. Each compartment shall have the following features:
    - a. Structural design and anchorage adequate to resist loads imposed by [125-mph (200-km/h)] <Insert wind speed> wind.
    - b. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
    - c. Louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.
    - d. Power for heaters, lights, and receptacles to be provided [**by control power transformer**] [**as indicated**].
  2. Weatherproof internal aisle construction shall have the following features:
    - a. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.
    - b. Aisle access doors at each end with exterior locking provisions and interior panic latches.
    - c. Aisle space heaters operating at one-half or less of rated voltage, thermostatically controlled.
    - d. Vaporproof fluorescent aisle lights with low-temperature ballasts, controlled by wall switch at each entrance.
    - e. GFCI duplex receptacles, a minimum of two, located in aisle.
    - f. Aisle ventilation louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.
- C. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.
- D. Bus Transition Unit: Arranged to suit bus and adjacent units.
- E. Incoming-Line Unit: Arranged to suit incoming line.
- F. Outgoing Feeder Units: Arranged to suit distribution feeders.
- G. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.
- H. Key Interlocks: Arranged to effect interlocking schemes indicated.



- I. Provisions for Future Key Interlocks: Mountings and hardware required for future installation of locks, where indicated.

## 2.5 COMPONENTS

- A. Main Bus: [**Copper, silver plated at connection points**] [**Copper, tin plated**]; full length of switchgear.
- B. Ground Bus: Copper, silver plated or copper, tin plated; minimum size **1/4 by 2 inches** (6 by 50 mm); full length of switchgear.
- C. Bus Insulation: Covered with flame-retardant insulation.
- D. Instrument Transformers: Comply with IEEE C57.13.
  1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
  2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.
- E. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems, listed and labeled by an NRTL, and with the following features:
  1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
  2. Switch-selectable digital display with the following features:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Three-Phase Real Power: Plus or minus 2 percent.
    - e. Three-Phase Reactive Power: Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
    - i. Accumulated energy, in **megawatt hours** (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
  3. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to Section 260913 "Electrical Power Monitoring and Control."
  4. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door.
- F. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- G. Control Power Supply: DC battery system.

- H. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
  2. Conductors sized according to NFPA 70 for duty required.

## 2.6 CONTROL BATTERY SYSTEM

- A. System Requirements: Battery shall have number of cells and ampere-hour capacity based on an initial specific gravity of 1.210 at 25 deg C with electrolyte at normal level and minimum ambient temperature of 13 deg C. Cycle battery before shipment to guarantee rated capacity on installation. Arrange battery to operate ungrounded.
- B. Battery: Lead-calcium type in sealed, clear plastic or glass containers, complete with electrolyte, fully charged and arranged for shipment with electrolyte in cells. Limit weight of each container to not more than **70 lb (32 kg)** and cells per container to not more than 3. System batteries shall be suitable for service at an ambient temperature ranging from minus 18 to 25 deg C. Limit variation of current output to 0.8 percent for each degree below 25 deg C down to minus 8 deg C.
- C. Rack: Two-step rack with electrical connections between battery cells and between rows of cells; include two flexible connectors with bolted-type terminals for output leads. Rate battery rack, cell supports, and anchorage for seismic requirements.
- D. Accessories:
1. Thermometers with specific-gravity correction scales.
  2. Hydrometer syringes.
  3. Set of socket wrenches and other tools required for battery maintenance.
  4. Wall-mounting, nonmetallic storage rack fitted to store above items.
  5. Set of cell numerals.
- E. Charger: Static-type silicon rectifier equipped with automatic regulation and provision for manual and automatic adjustment of charging rate. Unit shall automatically maintain output voltage within 0.5 percent from no load to rated charger output current, with ac input-voltage variation of plus or minus 10 percent and input-frequency variation of plus or minus 3 Hz. Other features of charger include the following:
1. DC ammeter.
  2. DC Voltmeter: Maximum error of 5 percent at full-charge voltage; operates with toggle switch to select between battery and charger voltages.
  3. Ground Indication: Two appropriately labeled lights to indicate circuit ground, connected in series between negative and positive terminals, with midpoint junction connected to ground by normally open push-button contact.
  4. Capacity: Sufficient to supply steady load, float-charge battery between 2.20 and 2.25 V per cell and equalizing charge at 2.33 V per cell.

5. Charging-Rate Switch: Manually operated switch provides for transferring to higher charging rate. Charger operates automatically after switch operation until manually reset.
6. AC power supply is 120 V, 60 Hz, subject to plus or minus 10 percent variation in voltage and plus or minus 3-Hz variation in frequency. After loss of ac power supply for any interval, charger automatically resumes charging battery. Charger regulates rate of charge to prevent damage due to overload and to prevent fuses or circuit breakers from opening.
7. Protective Feature: Current-limiting device or circuit, which limits output current to rating of charger but does not disconnect charger from either battery or ac supply; to protect charger from damage due to overload, including short circuit on output terminals.
8. Electrical Filtering: Reduces charger's audible noise to less than 26 dB.

## 2.7 IDENTIFICATION

- A. Materials: Refer to Section 260553 "Identification for Electrical Systems." Identify units, devices, controls, and wiring.
- B. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish Master nameplate giving switchgear designation, voltage ampere rating, short circuit rating, manufacturer's name, general order number and item number.
- C. Mimic Bus: Continuous mimic bus applied to front of switchgear, arranged in single-line diagram format, using symbols and lettered designations consistent with approved final mimic-bus diagram.
  1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
  2. Medium: Painted graphics, as approved.
  3. Color: Contrasting with factory-finish background; selected by DEN Project Manager.

## 2.8 SOURCE QUALITY CONTROL

- A. Before shipment of equipment, perform the following tests and prepare test reports:
  1. Production tests on circuit breakers according to ANSI C37.09.
  2. Production tests on completed switchgear assembly according to IEEE C37.20.2.
- B. Assemble switchgear and equipment in manufacturer's plant and perform the following:
  1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.

2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets.

C. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

2.9 FACTORY FINISHES

- A. Finish: Manufacturer's standard color finish applied to equipment before shipping.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 AUTOMATIC THROWOVER CONTROL SCHEME

A. Sequence of Operation:

1. If Service #1 is selected as the preferred service, Breaker 52M1 will be closed and Breaker 52M2 will be open. Switchboard will be supported by Service #1.
2. If Service #2 is selected as the preferred service, Breaker 52M2 will be closed and Breaker 52M1 will be open. Switchboard will be supported by Service #2.
3. If Service #1 is selected as the preferred service, and Service #1 fails with Service #2 available and Breaker 52M1 not tripped due to a fault (bell alarm lockout) proceed as follows:
  - a. After an adjustable time delay (1.5 - 15 seconds) trip Breaker 52M1.
  - b. Once Breaker 52M1 is open, close Breaker 52M2. Note that this is an open transition transfer with no paralleling.
  - c. Continue to operate entire switchboard on Service #2.
4. If Service #1 is selected as the preferred service, Step "3" has occurred, and Service #1 returns to service, proceed as follows:
  - a. Initiate an adjustable time delay (6 - 60 minutes).

- b. Upon expiration of the time delay trip Breaker 52M2.
      - c. After an adjustable time delay (.2-60 seconds) close Breaker 52M1.
      - d. System is restored to normal.
  5. Service #2 is selected as the preferred service, and Service #2 fails with Service #1 available and Breaker 52M2 not tripped due to a fault (bell alarm lockout), proceed as follows:
    - a. After an adjustable time delay (1.5 - 15 seconds) trip Breaker 52M2.
    - b. Once Breaker 52M2 is open, close Breaker 52M1. Note that this is an open transition transfer with no paralleling.
    - c. Continue to operate entire Switchboard on Service #1.
  6. If Service #2 is selected as the preferred service, step "5" has occurred and Service #2 returns to service, proceed as follows:
    - a. Initiate an adjustable time delay (6 - 60 minutes).
    - b. Upon expiration of the time delay trip Breaker 52M1.
    - c. After an adjustable time delay (.2 - 60 seconds) close Breaker 52M2.
    - d. System is restored to normal.
  7. Remote service equipment shutdown. ( 86 relay )
    - a. In case of an emergency, the service equipment main circuit breakers 52 M1 and 52 M2, to be remotely disconnected and to remain in open position until manually reset locally by a trained electrician. Remote indicator lights shall be located at outside entrance to switchgear room to indicate when the ( 86 relay ) is engaged.
- B. Additional Features:
1. Provide bell alarm lockouts such that upon a fault in the distribution bus, both main breakers shall be given trip signals and locked out from closing until reset.
  2. Provide electrical interlocks to ensure that only one of the two main breakers can be closed at the same time.
  3. A manual/auto selector switch to completely disable the automatic throwover scheme.
  4. A time delay bypass switch on retransfer to normal to allow immediate return to normal configuration upon restoration of the failed transformer (momentary contact).
  5. A selector switch to advise the automatic throwover scheme as to which transformer is preferred.
  6. Provide a control power transfer scheme. Control power transformers shall be connected on the line side of each secondary main breaker and the scheme shall automatically transfer to the source that is available to supply control power to the switchboard.
  7. Provide control switches for Breakers 52M1 and 52M2.
  8. Provide pilot lights for the following conditions:
    - a. Automatic mode.

- b. Manual mode (flashing).
    - c. Breaker 52M1 open.
    - d. Breaker 52M1 closed.
    - e. Breaker 52M1 trip.
    - f. Breaker 52M2 open.
    - g. Breaker 52M2 closed.
    - h. Breaker 52M2 trip.
    - i. Service #1 preferred.
    - j. Service #2 preferred.
    - k. Service #1 available.
    - l. Service #2 available.
    - m. Switchboard on alternate transformer (flashing).
    - n. Remote indicators outside of main switchgear electrical room.
      - 1) Remote disconnect engaged.
      - 2) M1 open.
      - 3) M2 open.
  9. Push to test feature on all pilot lights.
  10. Dry contact relay outputs for the following conditions:
    - a. Manual-auto switch-auto.
    - b. Manual-auto switch-manual.
    - c. Switchboard on alternate service.
    - d. Alternate service unavailable.
    - e. Preferred service failed.
    - f. Breaker 52M1 tripped (bell alarm).
    - g. Breaker 52M2 tripped (bell alarm).
    - h. Outage on switchboard.
    - i. Control power failed.
  11. All necessary relays, selector switches, pilot lights (except for potential transformers and control transformers) and other components for the automatic throwover and emergency remote service equipment shutdown scheme shall be located in a cubicle shown on the drawings.
  12. Mount all control switches and pilot lights on the cubicle door such that they are accessible from outside. Provide suitable nameplates for all devices.
  13. Provide a complete relay schedule listing all relays and controls as well as a complete circuit operation description. Indicate in detail the operation of all relays and contacts for all contingencies.
  14. All device numbering should conform to ANSI/IEEE Standards.
- C. Breakers 52M1 and 52M2:
1. Provide the following features and accessories on Breakers 52M1 and 52M2 to interface with the automatic throwover control scheme:
    - a. All auxiliary contacts required for the operation of the automatic throwover and emergency remote service equipment shutdown control scheme.
    - b. Four spare sets of Form "C" (normally open/normally closed auxiliary

- contacts)
- c. 120 volt electric operators. Note that these breakers will be operated by relay logic. Do not provide local (at breaker) push buttons or controls. In addition, make provisions to block local manual closing to prevent override of interlocking scheme.

### 3.3 INSTALLATION

- A. Anchor switchgear assembly to **4-inch** (100-mm), channel-iron sill embedded in concrete base and attach by bolting.
  - 1. Sills: Select to suit switchgear; level and grout flush into concrete base.
  - 2. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.
  - 3. Concrete Bases: **4 inches** (100 mm) high, reinforced, with chamfered edges. Extend base no less than **3 inches** (75 mm) in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."
- B. Diagram and Instructions:
  - 1. Frame under clear acrylic plastic on front of switchgear.
    - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
    - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
  - 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

### 3.5 CONNECTIONS

- A. Cable terminations at switchgear are specified in Section 260513 "Medium-Voltage Cables."

- B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260513 "Medium-Voltage Cables."

### 3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
    - a. Switchgear.
    - b. Circuit breakers.
    - c. Instrument transformers.
    - d. Metering and instrumentation.
    - e. Ground-fault systems.
    - f. Battery systems.
    - g. Capacitors.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
  - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
  - 2. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.



### 3.7 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics [**according to results in Section 260573 "Overcurrent Protective Device Coordination Study."**][.]

### 3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

### 3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

### 3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Section 017900 "Demonstration and Training."
  - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

## END OF SECTION 261300

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.
  - 2. Buck-boost transformers.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means, "The unit will remain in place without

separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

B. Handle using only lift eyes and provided brackets. Protect equipment in inclement

weather.

## 1.8 COORDINATION

- A. For floor-mounted transformers, coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. For wall-mounted and structure-mounted transformers, coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## 1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. **Manufacturers: Match existing equipment in the vicinity, if applicable. Subject to compliance with requirements, provide products by one of the following:**
  - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 2. General Electric Company.
  - 3. Square D; Schneider Electric.
  - 4. or approved equal.

### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material:
  - 3. Transformers rated up to 45kVA: **Copper or Aluminum.**
    - a. Transformers rated above 45kVA: Copper windings are required."

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: [**Ventilated**] [**Totally enclosed, nonventilated**], NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Enclosure: [**Ventilated**] [**Totally enclosed, nonventilated**], . NEMA 250, [**Type 3R**] [**Type 4X, stainless steel**].
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- G. Taps for Transformers Smaller than 3 kVA: **None**.
- H. Taps for Transformers 7.5 to 24 kVA: "**One 5 percent tap above and one 5 percent tap below normal full capacity**."
- I. Taps for Transformers 25 kVA and Larger: **Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity**.
- J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of [**115**] [**80**] deg C rise above 40 deg C ambient temperature.
- K. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  - 2. Indicate value of K-factor on transformer nameplate.
- M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.
3. Shield Effectiveness:
  - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
  - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
  - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

N. Wall Brackets: Manufacturer's standard brackets.

O. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91. Maximum sound levels shall be as follows:

1. 1 to 5 kVA: 37dB.
2. 6 to 25 kVA: 42dB.
3. 26 to 150 kVA: 47dB.
4. 151 to 225 kVA: 52dB.
5. 226 to 300 kVA: 52dB.
6. 301 to 500 kVA: 57dB.

## 2.4 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2.

1. Finish Color: **Gray**] [**ANSI 49 gray**] [**ANSI 61 gray**].

## 2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each **distribution** and **buck-boost** transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

1. Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, **seismic codes applicable to Project**, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Perform two (2) follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
  - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.



## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

## **PART 5 - PAYMENT**

### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 262200

## SECTION 262413 - SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Service and distribution switchboards rated 600 V and less.
  - 2. Surge protection devices.
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Control power.
  - 6. Accessory components and features.
  - 7. Identification.
  - 8. Mimic bus.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to [SEI/ASCE 7] <Insert requirement>.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[ **and the unit will be fully operational after the seismic event**]."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer**] [**testing agency**].
- B. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective

devices.

3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two (2) of each size and type.
  2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two (2) of each size and type.
  3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three (3) of each size and type.
  4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three (3) of each size and type.
  5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three (3) of each size and type.
  6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one (1) of each size and type.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and [**install temporary electric heating (250 W per section)**] [**connect factory-installed space heaters to temporary electrical service**] to prevent condensation.
- C. Handle and prepare switchboards for installation according to [**NECA 400**] [**NEMA PB 2.1**].

1.10 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Location: Indoors/outdoors.
    - b. Ambient Temperature: Not exceeding 120 deg F (49 deg C).
    - c. Altitude: 5500 feet (1677 m), not exceeding 6600 feet (2000 m).
- C. Unusual Service Conditions: NEMA PB 2, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet (2000 m).
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without DEN Project Manager's written permission.
  - 4. Comply with NFPA 70E.

## 1.11 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

## 1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

## 1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
  - 5. <Insert manufacturer>
  - 6. or approved equal.
- B. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: [**Panel**] [**Fixed, individually**] mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.

- C. Front- and Side-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
  2. Branch Devices: Panel mounted.
  3. Sections front and rear aligned.
- D. Front- and Rear-Accessible Switchboards:
1. Main Devices: **[Fixed, individually]** **[Drawout]** mounted.
  2. Branch Devices: **[Panel]** **[Fixed, individually]** **[Panel and fixed, individually]** **[Fixed and individually compartmented]** **[Individually compartmented and drawout]** mounted.
  3. Sections **[front and rear]** **[rear]** aligned.
- E. Nominal System Voltage: **[480Y/277 V]** **[208Y/120 V]** **<Insert system voltage>**.
- F. Main-Bus Continuous: **[5000]** **[4000]** **[3000]** **[2500]** **[2000]** **[1600]** **[1200]** **<Insert ampere rating>** A.
- G. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- H. Indoor Enclosures: Steel, NEMA 250, **[Type 1]** **[Type 5]**.
- I. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's **[standard gray]** **[custom color]** finish over a rust-inhibiting primer on treated metal surface.
- J. Outdoor Enclosures: **[Type 3R]** **[Type 3R, with interior-lighted walk-in aisle]**.
1. Finish: Factory-applied finish in manufacturer's **[standard]** **[custom]** color; undersurfaces treated with corrosion-resistant undercoating.
  2. Enclosure: **[Flat]** **[Downward, rearward sloping]** roof; **[bolt-on rear covers]** **[rear hinged doors]** for each section, with provisions for padlocking.
  3. Doors: Personnel door at each end of aisle, minimum width of **[30 inches (762 mm)]** **<Insert value>**; opening outwards; with panic hardware and provisions for **[padlocking]** **[cylinder lock]**.
  4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.
  5. Walk-in Aisle Heating and Ventilating:
    - a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of **[40 deg F (5 deg C)]** **<Insert temperature>** with outside design temperature of **[minus 30 deg F (minus 35 deg C)]** **<Insert temperature>**.
    - b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of **[100 deg F (38 deg C)]** **<Insert temperature>** with

- outside design temperature of [**120 deg F (49 deg C)**] <Insert temperature>.
- c. Ventilating openings[ **complete with replaceable fiberglass air filters**].
  - d. Thermostat: Single stage; wired to control heat and exhaust fan.
6. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer within the switchboard. Supply voltage shall be [**120**] [**120/240**] [**120/208**]-V ac.
7. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.
- K. Barriers: Between adjacent switchboard sections.
- L. Insulation and isolation for[ **main bus of main section and**] main and vertical buses of feeder sections.
- M. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
- 1. Space-Heater Control: [**Thermostats to maintain temperature of each section above expected dew point**] [**Manual switching of branch-circuit protective device**].
  - 2. Space-Heater Power Source: [**Transformer, factory installed in switchboard**] [**120-V external branch circuit**].
- N. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- O. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.[ **Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.**]
- P. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- Q. Removable, Hinged Rear Doors and Compartment Covers: Secured by [**captive thumb screws**] [**standard bolts**], for access to rear interior of switchboard.
- R. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- S. Pull Box on Top of Switchboard:



1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

T. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, **[silver-plated,** ]with tin-plated copper feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with **[mechanical] [compression]** connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: **[1/4-by-2-inch- (6-by-50-mm-)] [1/4-by-1-inch- (6-by-25-mm-)]** **[Minimum-size required by UL 891,]** hard-drawn copper of 98 percent conductivity, equipped with **[mechanical] [compression]** connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with **[mechanical] [compression]** connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
6. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with **[mechanical] [compression]** connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
7. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

U. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

V. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

W. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

## 2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
  5. **<Insert manufacturer>**
  6. or approved equal.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, **[wired-in] [plug-in] [bolt-on]**, solid-state, parallel-connected, **[modular (with field-replaceable modules)] [non-modular]** type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
  2. Fabrication using bolted compression lugs for internal wiring.
  3. Integral disconnect switch.
  4. Redundant suppression circuits.
  5. Redundant replaceable modules.
  6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  7. LED indicator lights for power and protection status.
  8. Audible alarm, with silencing switch, to indicate when protection has failed.
  9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  10. **[Four] [Six]**-digit, transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: **[160 kA per mode/320 kA per phase] [120 kA per mode/240 kA per phase] [80 kA per mode/160 kA per phase]**.
- D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with **[480Y/277] [208Y/120] [600Y/347]**-V, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
  2. Line to Ground: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
  3. Neutral to Ground: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
- F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
  2. Line to Ground: 400 V.

3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

1. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].
2. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**series-connected rating**] [**interrupting capacity**] to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and I<sub>2</sub>t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: [**Mechanical**] [**Compression**] style, suitable for number, size, trip ratings, and conductor material.
  - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
  - d. Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  - f. Communication Capability: [**Circuit-breaker-mounted**]

- [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
- g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
  - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - i. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Insulated-Case Circuit Breaker (ICCB): [**80**] [**100**] percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. [**Fixed**] [**Drawout**] circuit-breaker mounting.
  2. Two-step, stored-energy closing.
  3. [**Standard**] [**Full**]-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time time adjustments.
    - c. Ground-fault pickup level, time delay, and I<sub>2t</sub> response.
    - d. <**Insert settings**>.
  4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  5. Remote trip indication and control.
  6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
  7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  8. Control Voltage: [**40-V dc**] [**125-V dc**] [**250-V dc**] [**120-V ac**].
- C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boltswitch, Inc.
    - b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - c. Pringle Electrical Manufacturing Company, Inc.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
    - f. <**Insert manufacturer**>

- g. or approved equal.
  - 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  - 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
    - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
  - 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  - 5. Service-Rated Switches: Labeled for use as service equipment.
  - 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
  - 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- D. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - b. <Insert manufacturer>
    - c. or approved equal.
  - 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  - 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
    - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal

- from ground-fault relay or remote-control device, causes switch to open.
- b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
- 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  - 5. Service-Rated Switches: Labeled for use as service equipment.
  - 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
  - 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - F. Fuses are specified in Section 262813 "Fuses."

## 2.4 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
  - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
  - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
  - a. Phase Currents, Each Phase: Plus or minus 1 percent.
  - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
  - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
  - d. Megawatts: Plus or minus 2 percent.
  - e. Megavars: Plus or minus 2 percent.
  - f. Power Factor: Plus or minus 2 percent.
  - g. Frequency: Plus or minus 0.5 percent.
  - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
  - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
  - j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Impulse-Totalizing Demand Meter:

1. Comply with ANSI C12.1.
2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording [5] [15] [30] <Insert time period>-minute integrated demand of totalized system.

2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Control Circuits: <Insert control voltage>-V dc.
- D. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- E. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

- F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

## 2.7 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
  - 1. Nameplate: At least **0.032-inch**- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
  - 1. Nameplate: At least **0.0625-inch**- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards



with one or more service disconnecting and overcurrent protective devices.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Receive, inspect, handle, and store switchboards according to **[NECA 400] [NEMA PB 2.1]**.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install switchboards and accessories according to **[NECA 400] [NEMA PB 2.1]**.
- B. Equipment Mounting: Install switchboards on concrete base, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in **[Section 033000 "Cast-in-Place Concrete. "] [Section 033053 "Miscellaneous Cast-in-Place Concrete. "]**
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.

- G. Install overcurrent protective devices, surge protection devices, and instrumentation.
  - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

### 3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. **Perform tests and inspections.**
  - 1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. **Acceptance Testing Preparation:**
  - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. **Tests and Inspections:**

1. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges [**as indicated.**] [**as specified in Section 260573 "Overcurrent Protective Device Coordination Study."**]

### 3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### 3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories[, **and to use and reprogram microprocessor-based trip, monitoring, and communication units.**]

1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

## PART 5 - PAYMENT

### 5.1 METHOD OF PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 262413

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.
  - 4. Electronic-grade panelboards.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.
  - 1. The term "withstand" means, "The unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**]."

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  3. Detail bus configuration, current, and voltage ratings.
  4. Short-circuit current rating of panelboards and overcurrent protective devices.
  5. Include evidence of NRTL listing for series rating of installed devices.
  6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  7. Include wiring diagrams for power, signal, and control wiring.
  8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Panelboard Schedules: For installation in panelboards. [ **Submit final versions after load balancing.** ]

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: [**Two (2)**] <Insert number> spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: [**Two (2)**] <Insert number> spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. <Insert extra materials>.

#### 1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to [**NECA 407**] [**NEMA PB 1**].

#### 1.11 PROJECT CONDITIONS

- A. Environmental Limitations:
  1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the

- construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding minus 30 deg F (minus 35 deg C) to plus 120 deg F (plus 49 deg C).
    - b. Altitude: **5500 feet** (1677 m), not exceeding **6600 feet** (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
  2. Altitude: 5500 feet, not exceeding **6600 feet** (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown.
  2. Do not proceed with interruption of electric service without DEN Project Manager's written permission.
  3. Comply with NFPA 70E.

#### 1.12 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.13 WARRANTY

- A. Special Warranty: for Surge Suppression Devices Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Minimum **[five (5)]** <Insert number> years from date of Substantial Completion.

#### 1.14 CONSTRUCTION WASTE MANAGEMENT



- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: **[Flush] [Surface] [Flush- and surface]**-mounted cabinets.
1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, **[Type 1] <Insert type>**.
    - b. Outdoor Locations: NEMA 250, **[Type 3R] <Insert type>**.
    - c. **[Kitchen] [Wash-Down]** Areas: NEMA 250, **[Type 4X] <Insert type>**, **[stainless steel] <Insert material>**.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, **[Type 4] <Insert type>**.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, **[Type 5] [Type 12]**.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: **[Steel] [and] [galvanized steel]**, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: **[Galvanized steel] [Same finish as panels and trim]**.
  7. Enclosures shall be at least 20 inches wide made from galvanized sheet steel in the sizes and NEMA types indicated, code gauge, minimum 16 gauge thickness
  8. Directory Card: Inside panelboard door, mounted in **[transparent card holder] [metal frame with transparent protective cover]**.
  9. **<Insert optional features>**.
- C. In all cases where the conductor to be connected to the busbar is 1/0 or larger cable, the connection shall be made with a 2-hole compression lug. Torque all lug, wire and bus terminations to the manufacturers recommendation using a micrometer type

- wrench.
- D. Incoming Mains Location: [**Top**] [**Bottom**] [**Top and bottom**].
- E. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads, with a corresponding increase in the size of the grounded conductor back to the supply.
  5. Split Bus: Vertical buses divided into individual vertical sections.
  6. <Insert optional features>.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: **Mechanical** type.
  3. Ground Lugs and Bus-Configured Terminators: **Mechanical** type.
  4. Feed-Through Lugs: **Mechanical** type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Subfeed (Double) Lugs: **Mechanical** type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Gutter-Tap Lugs: **Mechanical** type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
  8. <Insert optional features>.
- G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- J. Breakers shall have built-in test points for testing long delay, and instantaneous functions of the breaker by means of a 120 volt operated test kit.
- K. General Requirements for Branch Circuit Panelboards:
1. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers, of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

2. Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and up through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be UL listed as Type SWD for lighting circuits.
  - a. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management and control system (EMCS) panels and fire alarm panels.
  - b. Main circuit breaker, when shown, shall be vertical mounted top or bottom as required. Chassis mounted reverse fed main circuit breaker is not acceptable.
3. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical at 240 volts and 14,000 amperes symmetrical at 480 volts.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Match existing manufacturer in the immediate area, if applicable. Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Square D; a brand of Schneider Electric.
  4. or approved equal.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: **[Circuit breaker] [Lugs only]**.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: **[Plug-in] [Bolt-on]** circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, **[electrically] [mechanically]** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
  2. External Control-Power Source: **[120-V branch circuit] [24-V control circuit] <Insert requirement>**.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Square D; a brand of Schneider Electric.
  4. or approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: **[Circuit breaker] [or] [lugs only]**.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, **[electrically] [mechanically]** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
  2. External Control-Power Source: **[120-V branch circuit] [24-V control circuit] <Insert requirement>**.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

## 2.4 ELECTRONIC-GRADE PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Square D; a brand of Schneider Electric.
  4. or approved equal.
- B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
  2. Copper equipment and isolated ground buses.
- G. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, **[plug-in]** **[wired-in]** **[bolt-on]**, solid-state, parallel-connected, **[modular (with field-replaceable modules)]** type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.
1. Accessories:
    - a. Fuses rated at 200-kA interrupting capacity.
    - b. Fabrication using bolted compression lugs for internal wiring.
    - c. Integral disconnect switch.
    - d. Redundant suppression circuits.
    - e. Redundant replaceable modules.
    - f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    - g. LED indicator lights for power and protection status.
    - h. Audible alarm, with silencing switch, to indicate when protection has failed.
    - i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - j. **[Four]** **[Six]**-digit, transient-event counter set to totalize transient surges.
  2. Peak Single-Impulse Surge Current Rating: **[160 kA per mode/320 kA per phase]** **[120 kA per mode/240 kA per phase]** **[80 kA per mode/160 kA per phase]**.
  3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
    - a. Line to Neutral: **70,000**A.
    - b. Line to Ground: **[70,000]** **<Insert value>** A.
    - c. Neutral to Ground: **[50,000]** **<Insert value>** A.
  4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
  5. Protection modes and UL 1449 SVR for grounded wye circuits with **[480Y/277]** **[208Y/120]** **[600Y/347]**-V, three-phase, four-wire circuits shall be as follows:
    - a. Line to Neutral: **[800 V for 480Y/277]** **[400 V for 208Y/120]** **[1200 V for 600Y/347]**.
    - b. Line to Ground: **[800 V for 480Y/277]** **[400 V for 208Y/120]** **[1200 V for 600Y/347]**.
    - c. Neutral to Ground: **[800 V for 480Y/277]** **[400 V for 208Y/120]** **[1200 V for 600Y/347]**.

6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:
  - a. Line to Neutral: 400 V.
  - b. Line to Ground: 400 V.
  - c. Neutral to Ground: 400 V.
7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
  - a. Line to Neutral: 400 V, 800 V from high leg.
  - b. Line to Ground: 400 V.
  - c. Neutral to Ground: 400 V.
8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
  - a. Line to Line: [2000 V for 480 V] [1000 V for 240 V] [2500 V for 600 V].
  - b. Line to Ground: [1500 V for 480 V] [800 V for 240 V] [2500 V for 600 V].

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Square D; a brand of Schneider Electric.
  4. or approved equal.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with fully-rated **interrupting capacity** to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 600 A and below.
  2. Breakers with frame sizes above 600 amperes shall be solid state trip, complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings. Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.
  3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  4. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.

- c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and I2t response.
5. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  8. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  9. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: **Mechanical** style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
    - f. Shunt Trip: [**120**] [**24**] <Insert voltage>-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
    - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [**without intentional**] [**with field-adjustable 0.1- to 0.6-second**] time delay.
    - h. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on**] [**off**] [**on or off**] position.
    - n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable

handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: **[One]** **[Two]** normally open and normally closed contact(s) that operate with switch handle operation.

## 2.6 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Current Technology; a subsidiary of Danahar Corporation.
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Liebert Corporation.
  5. Square D; a brand of Schneider Electric.
  6. or approved equal.
- B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
    - a. LED indicator lights for power and protection status.
    - b. Audible alarm, with silencing switch, to indicate when protection has failed.
    - c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
- C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, **[plug-in]** **[wired-in]** **[bolt-on]**, solid-state, parallel-connected, **[modular (with field-replaceable modules)]** **[non-modular]** type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
    - a. Fuses rated at 200-kA interrupting capacity.
    - b. Fabrication using bolted compression lugs for internal wiring.
    - c. Integral disconnect switch.
    - d. Redundant suppression circuits.
    - e. Redundant replaceable modules.
    - f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.



- g. LED indicator lights for power and protection status.
  - h. Audible alarm, with silencing switch, to indicate when protection has failed.
  - i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  - j. **[Four] [Six]**-digit, transient-event counter set to totalize transient surges.
2. Peak Single-Impulse Surge Current Rating: **[160 kA per mode/320 kA per phase] [120 kA per mode/240 kA per phase] [80 kA per mode/160 kA per phase]**.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
  - a. Line to Neutral: **[70,000] <Insert value>** A.
  - b. Line to Ground: **[70,000] <Insert value>** A.
  - c. Neutral to Ground: **[50,000] <Insert value>** A.
4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with **[480Y/277] [208Y/120] [600Y/347]**-V, three-phase, four-wire circuits shall be as follows:
  - a. Line to Neutral: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
  - b. Line to Ground: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
  - c. Neutral to Ground: **[800 V for 480Y/277] [400 V for 208Y/120] [1200 V for 600Y/347]**.
6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:
  - a. Line to Neutral: 400 V.
  - b. Line to Ground: 400 V.
  - c. Neutral to Ground: 400 V.
7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
  - a. Line to Neutral: 400 V, 800 V from high leg.
  - b. Line to Ground: 400 V.
  - c. Neutral to Ground: 400 V.
8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
  - a. Line to Line: **[2000 V for 480 V] [1000 V for 240 V] [2500 V for 600 V]**.
  - b. Line to Ground: **[1500 V for 480 V] [800 V for 240 V] [2500 V for 600 V]**.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to **[NECA 407] [NEMA PB 1.1]**.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to **[NECA 407] [NEMA PB 1.1]**.
- B. Equipment Mounting: Install panelboards on concrete bases, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in Section[s] **[03300 "Cast-in-Place Concrete"] [033053 "Miscellaneous Cast-in-Place Concrete"]**.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Section "Vibration and Seismic Controls for Electrical Systems."

- E. Mount top of trim [**78 inches (1982 mm)**] <Insert height> above finished floor unless matching height of existing equipment or approved otherwise.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub five 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub five 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties[ **after completing load balancing**].
- K. Comply with NECA 1.

### 3.3 PANELBOARD SCHEDULE

- A. Panelboards shall be furnished and equipped as follows, except as otherwise specified:

|               |           |           |             |
|---------------|-----------|-----------|-------------|
| Manufacturer: | 120/208V: | 277/480V: | 600- 1200A: |
| Cutler Hammer | PRL-1     | PRL-2     | PRL-3 or 4  |
| Square-D      | NQOD      | NEHB      | I-LINE      |
| GE            | NLAB      | NHB       | CCB         |

Or approved equal by other manufacturer.

- B. Panelboards may contain not more than one subfeed breaker with ratings in excess of 100A, but less than 225A.
- C. Distribution panelboard shall be scheduled where more than one subfeed breaker rated in excess of 100A is required, and for any panelboard containing breakers with ratings of 225A or more.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads[ **after balancing panelboard loads**]; incorporate Owner's final room designations. Clearly identify the load on each circuit, equipment serviced and location. Revise directory to reflect circuiting changes required to balance phase loads. In all instances where a contractor installs or disconnects a circuit in any panel, a newly typed panel schedule shall be furnished.

The new or revised panel schedule shall have the date and Contractor's name typed at the top right hand corner. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections, preparing a written report for each including test results:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard eleven (11) months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- F. Submit torque values for all connections with a torque schedule and witness signature.

### 3.6 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges [**as indicated**] [**as specified in Section "Arc Flash and Overcurrent Protective Device Coordination Study."**]
- C. Load Balancing: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

## PART 5 - PAYMENT

### 5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

**END OF SECTION 262416**

## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Grounding conductors.
- 2. Grounding connectors.
- 3. Grounding busbars.
- 4. Grounding rods.
- 5. Grounding labeling.

- B. Related Sections:

- 1. Section 260526 "Grounding and Bonding for Electrical Systems."

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

#### 1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. NRTL: Nationally Recognized Testing Laboratory
- D. TGB: Telecommunications grounding busbar.
- E. TMGB: Telecommunications main grounding busbar.

#### 1.4 SYSTEM DESCRIPTION

- A. Provide each communications room with a ground bar for equipment bonding.
- B. Provide minimum #6 copper grounding conductor from each communications room ground bar and connect to nearest referenced ground bar in the electrical room.

- C. Bond together all communications equipment racks, cable trays, equipment enclosures, and metal raceway systems. Connect to the nearest equipment ground bar.
- D. Requirements of this section shall be considered as a supplement to the requirements of 260526 "Grounding and Bonding for Electrical Systems."

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. Ground rods.
  - 2. Ground and roof rings.
  - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For **[Installer]**, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.
    - c. **<Insert field quality-control test results>**.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300



"Submittal Procedures".

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of ITS **[Technician] [Installer 2]**, who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Field Inspector: Currently registered by BICSI as **[a registered communications distribution designer] [ITS Installer 2]** to perform the on-site inspection.
- B. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.
- C. NFPA Compliance: NFPA 70 "National Electrical Code (NEC)," as adopted and amended by the Denver Building Code, Chapter 10.
- D. UL Compliance: Applicable requirements of UL Standards Nos. 467 "Electrical Grounding and Bonding Equipment," and 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits and equipment. In addition, require compliance with UL Std 486A, "Wire Connectors." Grounding and bonding products shall be UL-listed and labeled for the use.
- E. IEEE Compliance: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

## 1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Grounding Connection Accessories:
  - 1. Electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type of service required.

- B. Exothermic welded connections are required where grounding conductors connect to underground grounding conductors and to underground grounding electrodes, and for bonding to steel. All underground connections shall be exothermic welded.
- C. All ground wires shall be copper except where stainless steel is specified for manholes, sized according to the NEC or as shown on the drawings whichever is larger.

## 2.2 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

## 2.3 CONDUCTORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Harger Lightning and Grounding.](#)
2. [Panduit Corp.](#)
3. [Tyco Electronics Corp.](#)
4. **<Insert manufacturer's name>.**
5. or approved equal.

- B. Comply with UL 486A-486B.

- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

- D. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG [**26 kcmils (13.3 sq. mm)**] and not longer than **12 inches (300 mm)**. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

- E. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: **28 kcmils (14.2 sq. mm)**, 14 strands of No. 17 AWG conductor, and **1/4 inch (6.3 mm)** in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

## 2.4 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
  1. [Burndy; Part of Hubbell Electrical Systems.](#)
  2. [Chatsworth Products, Inc.](#)
  3. [Harger Lightning and Grounding.](#)
  4. [Panduit Corp.](#)
  5. [Tyco Electronics Corp.](#)
  6. **<Insert manufacturer's name>.**
  7. or approved equal.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless [**compression**] [or] [**exothermic**]-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.5 GROUNDING BUSBARS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
  1. [Chatsworth Products, Inc.](#)
  2. [Harger Lightning and Grounding.](#)
  3. [Panduit Corp.](#)
  4. **<Insert manufacturer's name>.**
  5. or approved equal.

- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, [**1/4 by 4 inches (6.3 by 100 mm)**] <Insert dimensions> in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide a [**4-inch ((100-mm))**] <Insert dimension> clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, [**1/4 by 3 inches (6.3 by 50 mm)**] <Insert dimensions> in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50-mm)) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  2. Rack-Mounted Horizontal Busbar: Designed for mounting in **19- or 23-inch (483- or 584-mm)** equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
  3. Rack-Mounted Vertical Busbar: **72 or 36 inches ((1827 or 914 mm))** long, with stainless-steel or copper-plated hardware for attachment to the rack.

## 2.6 GROUND RODS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Harger Lightning and Grounding](#).
  2. [Tyco Electronics Corp.](#)
  3. <Insert manufacturer's name>.
  4. or approved equal.
- B. Ground Rods: Copper-clad steel, 3/4 inch by minimum **10 feet (19 mm by 3 m)** in

diameter.

1. In manholes, ground rods shall be stainless steel ¾-inch diameter and a minimum length of 10 feet.

## 2.7 LABELING

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Brother International Corporation](#).
  2. [HellermannTyton](#).
  3. [Panduit Corp.](#)
  4. **<Insert manufacturer's name>**.
  5. or approved equal.
- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.
- D. Supplementary Grounding Electrode: Use grounding mats, where indicated, or driven ground rods. Install ground rods in suitable recessed well; fill with gravel after connection is made.
- E. Provide a No. 6 AWG and ground plate to each Communications Room or board. Connect to nearest Electrical Room ground plate.
- F. Provide isolated and insulated ground conductors for all microprocessor and data processing equipment.
- G. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, connections are to be tightened to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- H. Provide code-sized ground cable bonding jumpers, installed with ground clamps, across all conduit expansion couplings and fittings, including flexible steel conduit used as expansion fittings.
- I. Provide a corrosion-resistant finish to field connections, buried metallic bonding products, and where factory applied protective coatings have been destroyed.
- J. All continuous runs of cable tray and all isolated sections of cable tray shall be bonded and grounded.

### 3.3 APPLICATION

- A. Conductors: Install solid conductor for **[No. 8] <Insert number>** AWG and smaller and stranded conductors for **[No. 6] <Insert number>** AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than **[No. 6] <Insert number>** AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than **[No. 6] <Insert number>** AWG.
- B. Underground Grounding Conductors: Install bare [~~tinned-~~]copper conductor, **[No. 2] <Insert number>** AWG minimum.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches ((900 mm).)

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
  - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than [No. 1/0] [No. 3/0] <Insert number> AWG.

### 3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

### 3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to

busbars.

- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
1. Use crimping tool and the die specific to the connector.
  2. Pretwist the conductor.
  3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than **2 kcmils/linear foot** (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG [**168 kcmils (85 sq. mm)**] unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install [**top-mounted**] [**vertically mounted**] rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- H. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- I. Access Floors: Bond all metal parts of access floors to the TGB.
- J. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using [**No. 6**] <**Insert number**> AWG bonding conductors.
1. Install the conductors in grid pattern on **4-foot (1200-mm)** centers, allowing bonding of one pedestal from each access floor tile.
  2. Bond the TGB of the equipment room to the reference grid at two or more locations.
  3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- K. Towers and Antennas:
1. Ground Ring: Buried at least **30 inches (760 mm)** below grade and at least **24**



- inches (610 mm) from the base of the tower or mounting.
2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
  3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
  4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
  5. Special Requirements for Roof-Mounted Towers:
    - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
    - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
    - c. Connect roof ring to the perimeter conductors of the lightning protection system.
  6. Waveguides and Coaxial Cable:
    - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
    - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

L. <Insert connections of other equipment>.

### 3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  2. Test the ground resistance to earth of each ground rod prior to connection to the system. Where test show resistance to ground is over 5 OHMS, report to DEN Project Manager locations and values. Submit test results to the DEN Project Manager.
  3. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  4. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB[ **and in each TGB**]. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds [**5**] **<Insert value>** ohms, notify DEN Project Manager promptly and include recommendations to reduce ground resistance.

- E. Grounding system will be considered defective if it does not pass tests and inspections. Correct all work that fails testing requirements and re-test system.
- F. Prepare test and inspection reports.

#### **PART 4 - MEASUREMENT**

##### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

#### **PART 5 - PAYMENT**

##### 5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

**END OF SECTION 270526**

## SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 260536 "Cable Trays for Electrical Systems" for cable tray systems.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
4. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.
5. Section 271100 "Communications Equipment Rooms and Fittings".

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.

- C. IMC: Intermediate metal conduit.
- D. IDF: Intermediate Distribution Facility
- E. MDF: Main Distribution Facility

#### 1.4 GENERAL

- A. Denver International Airport (DEN) owns and operates a private telecommunications infrastructure that provides voice, data and video services to all airport, airline and tenant facilities throughout the fifty-three square mile site. Tenants developing leasehold spaces or facilities on ground-leased sites are required to design their horizontal wiring pathways in accordance with these guidelines. Horizontal wiring pathways include all types of raceway systems to support voice, data, LAN, CATV and fiber cabling between DEN telecommunications rooms and outlets in the tenant, public or City areas.
- B. Designers are required to submit a complete set of plans and specifications for their projects to the DEN Telecommunications Department for review and approval. Designers are also required to meet with representatives from the DEN Telecommunications Department at one or more times during the course of design to work out specific interface details prior to the final submittal.
- C. Tenants and designers are encouraged to utilize the services of the current DEN Premise Wiring and Communications System (PWCS) contractor for installation of all horizontal cabling, outlets and termination. The City's contract with this contractor stipulates that all wiring and other components installed by the PWCS contractor be serviced and maintained by that contractor as part of the ongoing PWCS system maintenance agreement. The PWCS contractor is permitted to add a fair and reasonable amount to any such work to cover the expected maintenance through the duration of the current contract. The use of the PWCS contractor for this work affords the tenant a single party with end-to-end responsibility for the horizontal cabling system.
- D. A tenant may elect to install a privately owned and maintained system of horizontal wiring within its leasehold space. This wiring would extend from outlets within the leasehold area to a designated point of demarcation with the DEN PWCS system. In this configuration, circuits ordered through the PWCS contractor or regulated telephone company will be terminated and tagged at the designated point of demarcation. Responsibility for cross connecting these circuits from the point of demarcation to their final destination remains the responsibility of the tenant. The PWCS contractor will troubleshoot any reported problems with a circuit only as far as the designated point of demarcation.
- E. Any tenant vacating their leasehold space shall leave any horizontal wiring in place and in serviceable condition. This shall include outlets, horizontal wiring and termination blocks at the telecommunications equipment room.
- F. An effective Design of a building's Horizontal Wiring Pathway System should

meet the following criteria:

1. All applicable codes.
  2. Provide flexible cable distribution to workstation locations.
  3. Facilitate ongoing maintenance.
  4. Easily accommodate future changes in equipment and services.
  5. Minimize occupant disruption when horizontal pathways and spaces are accessed.
- G. The horizontal distribution system must be designed to accommodate all types of communications cabling (i.e., UTP, Coax, and Fiber Optic cabling). When determining the type and size of the cable pathway, consider the quantity and size of the cables that the pathway is intended to house, and potential for growth in the area served.
- H. When designing the horizontal distribution system it is important to consider Moves, Adds and Changes (MACs) and minimal disruption to immediate occupants.
- I. Electromagnetic Interference (EMI):
1. EMI causes severe problems with electronic equipment, telecommunications and data communications, avoidance of all potential sources or, electromagnetic interference must be a primary consideration when designing a horizontal distribution system. To avoid electromagnetic interference, all distribution pathways should provide clearances of at least:
    - a. Four (4) ft. (1.2 m) from large motors and/or transformers.
    - b. One (1) ft. (0.3 m) from conduit and cables used for electrical power distribution.
    - c. Five (5) in. (12 cm) from fluorescent lighting.
  2. Note: Horizontal Distribution Pathways should cross perpendicular to fluorescent lighting and electrical power cables or conduits.
- J. Horizontal Pathways must be grounded and bonded in accordance with the requirements specified in ANSI/NFPA 70, except where other codes or local authorities impose more stringent requirements.
- K. Maximum cable distance between any outlet and the telecommunications room, closet or cabinet shall not exceed ninety **295 feet** (90 meters).
- L. Conduit Entry to Telecommunications Rooms: Horizontal distribution conduits entering a telecommunications closet should terminate above the room's cable ladder system to allow for proper cable racking. If conduits are entering through the floor, they must terminate four (4) inches above the finished floor. Conduits must be reamed, equipped with a bonding bushing and terminated as close as possible to the terminating rack or wall. Provide a #6 AWG bare copper bonding connection between the bonding bushing(s) and cable ladder system or equipment room grounding bar.

## 1.5 INTERMEDIATE DISTRIBUTION FACILITIES

- A. Intermediate Distribution Facilities shall be provided at locations as required to reach any area of the facility with a 90-meter length of cabling. Reserve fifteen meters of this cabling length for patch cord connections between horizontal cabling terminations in the IDF and tenant LAN equipment in a directly adjacent tenant equipment room space.
- B. The IDF will serve as the demarcation point between the DEN Premise Wiring and Communications System backbone cabling system and horizontal cabling system. In addition to cable terminations, these rooms may contain active electronic equipment for DEN Local Area Network services, data circuit conditioning equipment, DEN access control (card reader) equipment, DEN closed circuit television equipment and other equipment that may be required by DEN Telecommunications to support the building.
- C. Tenant equipment shall not be permitted within any IDF room. Provide a separately accessible tenant equipment room to support tenant LAN equipment in lockable tenant provided cabinets. Cabling for tenant LAN services will be terminated in the DEN IDF room and extended with Category 5e jumpers to the tenant equipment.
- D. IDF rooms shall not be placed in locations that are subject to the effects of water infiltration, steam infiltration, humidity from nearby water or steam, excessive heat (e.g., direct sunlight) or any other corrosive atmospheric or environmental conditions. Avoid locations that are below grade unless preventive measures against water infiltration are employed. The room must be free of plumbing and electrical utilities that are not directly required to support the equipment room function. A floor drain is required if there is any risk of water entering the facility.
- E. NEC Section 110-16 requires three (3) feet of clear working space around equipment with exposed live parts. This shall apply to all communication equipment in the IDF room.
- F. Telecommunications equipment requires heating, ventilating and air conditioning equipment to functions properly at all times. All IDF spaces shall be designed to maintain a temperature range 64 degrees to 75 degrees F at 30 percent to 55 percent relative humidity. Heat Dissipation 750 to 5000 BTUs per cabinet (number of cabinets to be determined through consultation with DEN Telecommunications).
- G. The floor rating under distributed loading must be greater than 250 lb/ft.<sup>2</sup>. The floor loading under equipment racks and other concentrated loads must be greater than 1000 lbs per square foot. Floor finish shall be static resistant vinyl tile.
- H. IDF room walls should extend from the finished floor to the structural ceiling ( e.g., the slab), be covered with two coats of fire-retardant white or light colored paint, and carry a minimum fire rating of two hours or as required by the applicable codes and regulations. All equipment room walls shall be lined with

¾" fire retardant B/C plywood to a height of 8'-0" above the finished floor. Plywood shall be painted with fire retardant paint to match room finish.

- I. DEN Telecommunications generally does not recommend a finished ceiling in an IDF room as such ceilings impede the installation of raceways and cable pulling. A sealed dust-free concrete finish is acceptable. Where ceilings must be installed, the recommended height of the finished ceiling to the finished floor is a minimum of 8'-6" to allow for cable ladder and cabling above the racks and frames. Any ceiling protrusions (ventilation, sprinklers, etc.) must be placed to assure a minimum clearance height of 8 ft. The ceiling finish must minimize the introduction of dust, and be white to enhance room lighting. Hard, non-accessible ceilings shall not be used in IDF rooms under any circumstance.
- J. IDF rooms shall be provided with adequate and uniform lighting that provides a minimum equivalence of 540 lux (50 footcandles) when measured 3 ft. above the finished floor to illuminate wall mounted equipment and the front and rear surfaces of racks and frames. Locate lighting fixtures a minimum of 8 ft. 6 in. above the finished floor. Locate light switches near the entrance(s) to the equipment room. Power for lighting should not come from the same circuits as power for the communications equipment. Provide emergency lighting as required by applicable building codes.
- K. Each IDF room shall be provided with a 120/208Volt, 3-Phase, 4-wire load center served with a separate feeder. The size of this load center will vary with the size of the building and the type of demarcation equipment installed. Quadplex power receptacles with separate 20 amp circuit and isolated grounds, shall be mounted on every wall in the equipment room. Spacing shall be on six (6) foot centers and receptacles shall be located at 16-inches above the finished floor. Other power requirements (e.g., fluorescent lighting, motors, air conditioning equipment) shall be supplied by a separate feeder, conduit, and branch panel. Provide a UL listed transient voltage surge suppressor directly adjacent to the IDF load center. Connect suppressor to line buses through spare 3-pole circuit breaker. Connect suppressor ground and neutral conductor from suppressor to panel ground and neutral buses. Keep all leads short and as straight as possible. Nipple between suppressor and panel shall not exceed 3-inches. Provide 12" x 2" x 1/4" isolated ground bar directly below panel. Extend #6AWG bare conductor from ground bus on load center to ground bar. Extend #2AWG bare copper from ground bar to building electrical service ground.
- L. All IDF spaces shall be provided with smoke detector(s) interconnected with the building fire alarm system. Fire alarm components shall conform to applicable DEN standards and local codes. One portable type ABC fire extinguishers shall be located in the room close to the entrance.
- M. All IDF spaces equipped with a DEN access control system card reader inside and outside the IDF door. Equip door with door position switch, electric hinge and solenoid operated lockset which remains operable from inside the room at all times.



- N. A contiguous 12-inch wide cable ladder shall be provided around the full perimeter of all walls of the IDF room at a height of 84-inches measured from the bottom of the cable runway to the finished floor. Wall brackets used to support cable ladder shall be of sufficient length to allow the passage of a 4-inch EMT conduit between the cable ladder and finished wall. Provide bonding strap at all connections between sections of cable ladder. Provide one #6AWG bare copper bond from cable ladder system to IDF ground bar. Two-inch and larger conduits entering the room from above shall be terminated at a height of 24-inches above the cable ladder system. Smaller conduits shall terminate at a height of 12-inches above the cable ladder system. All conduits shall terminate with a bonding bushing which is in turn bonded individually or in groups to the cable ladder.
- O. Conduits entering the IDF from below shall be racked on a unistrut frame and terminated at approximately 8-inches above the floor with a bonding bushing. These bushings shall be bonded either individually or collectively to the IDF grounding bar with a #6AWG bare copper conductor. Provide a 6-inch concrete housekeeping curb around each conduit grouping as shown on the details that accompany this section.
- P. IDF rooms on multiple floors of a building shall be vertically aligned to permit the use of fire-safed sleeves between IDF rooms. Designers may wish to place IDF rooms adjacent to fixed vertical elements of the building such as elevators or stairwells as long as these vertical elements do not unduly restrict the entry of horizontal cabling into the IDF rooms. Do not allow conduit to be embedded in the floor or ceiling slab of any IDF room to allow for future core drilling between floors.
- Q. IDF Room Configuration and Sizes:
1. Reference **[Drawings] [Diagram attached at end of Section] <Insert location>** for DEN IDF Room Configuration plans.
- 1.6 ACTION SUBMITTALS
- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
  2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

- D. Samples: For **[wireways]** **[nonmetallic wireways]** **[and]** **[surface pathways]** and for each color and texture specified, **[12 inches (300 mm)]** **<Insert dimension>** long.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.
- D. As built drawings: Provide complete as-built drawings for all IDF rooms, backbone conduit routes and tray routes indicating actual routing.

#### 1.8 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
  - 1. Provide complete as-built drawings for all IDF rooms, backbone conduit routes and tray routes indicating actual routing.

#### 1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

### **PART 2 - PRODUCTS**

#### 2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Alpha Wire Company.
  - 4. Anamet Electrical, Inc.

5. Electri-Flex Company.
6. O-Z/Gedney; a brand of EGS Electrical Group.
7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
8. Republic Conduit.
9. Robroy Industries.
10. Southwire Company.
11. Thomas & Betts Corporation.
12. Western Tube and Conduit Corporation.
13. Wheatland Tube Company; a division of John Maneely Company.
14. <Insert manufacturer>
15. or approved equal.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.
3. 4-inch electrical metallic tubing or rigid metallic conduit may be used at above grade locations between MDF and IDF rooms or between IDF rooms. Refer to DEN standards for electrical raceways for the applicability of each type of conduit by location. All conduits shall terminate with bonding bushings at the IDF or MDF rooms which are bonded to the cable ladder system in the room.
4. Conduits entering the IDF from below shall be racked on a unistrut frame and terminated at approximately 8-inches above the floor with a bonding bushing. These bushings shall be bonded either individually or collectively to the IDF grounding bar with a #6 AWG bare copper conductor. Provide a 6-inch concrete housekeeping curb around each conduit grouping.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated [**rigid steel conduit**] [**IMC**].

1. Comply with NEMA RN 1.
2. Coating Thickness: **0.040 inch** (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: [**Setscrew**] [**or**] [**compression**].

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.
- J. Vertical (Backbone) Communications Pathways - Conduit:
1. 4-inch electrical metallic tubing or rigid metallic conduit may be used at above grade locations between MDF and IDF rooms or between IDF rooms. Refer to DEN standards for electrical raceways for the applicability of each type of conduit by location. All conduits shall terminate with bonding bushings at the IDF or MDF rooms that are bonded to the cable ladder system in the room.
  2. 4-inch schedule 40 PVC may be used in new construction between communications rooms. Conduit shall transition to PVC coated galvanized rigid steel at all elbows and at terminations at IDF or MDF rooms. Provide 4'-0" minimum radius on all bends. All conduits shall be provided with bonding bushings at equipment room terminations that are bonded either individually or collectively to the equipment room grounding bar.
  3. Conduits used for vertical cabling shall have no more than 270-degrees in bends. Straight-through pull boxes shall be used in conduit runs which exceed this value. Pull boxes shall be sufficiently large to accommodate the number of 4-inch conduits in the run assuming a single cable of 51% fill in each of the raceways. All pull boxes shall be equipped with hinged covers.
  4. All conduit shall be verified after installation by pulling a mandrel through the conduit that is 80% of the internal diameter of the conduit. After completion of the mandrel test install one 3/4" wide woven aramid fiber pull tape in each conduit. Feed tape straight through pull boxes without breaking or splicing. Pull tape shall provide 2500 pounds of tensile strength and be marked with consecutive footage numbers at one-foot intervals. Permanently tie off tapes at both ends.
  5. Upon completion vertical communications conduit shall be left clean, dry and unobstructed. Cap each conduit to prevent entry of debris. Provide a permanent label on the bonding bushing for each conduit indicating the number of the conduit and destination of the remote end.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Arnco Corporation.
5. CANTEX Inc.
6. CertainTeed Corp.
7. Condux International, Inc.
8. Electri-Flex Company.
9. Kraloy.
10. Lamson & Sessions; Carlon Electrical Products.
11. Niedax-Kleinhuis USA, Inc.
12. RACO; a Hubbell company.
13. Thomas & Betts Corporation.
14. <Insert manufacturer>
15. or approved equal.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.
3. 4-inch schedule 40 PVC may be used in new construction between communications rooms. Conduit shall transition to PVC coated galvanized rigid steel at all elbows and at terminations at IDF or MDF rooms. Provide 4'-0" minimum radius on all bends. All conduits shall be provided with bonding bushings at equipment room terminations that are bonded either individually or collectively to the equipment room grounding bar.

C. RNC: [**Type EPC-40-PVC**] <Insert type>, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. Arnco Corporation.
  - 3. Endot Industries Inc.
  - 4. IPEX.
  - 5. Lamson & Sessions; Carlon Electrical Products.
  - 6. **<Insert manufacturer>**
  - 7. or approved equal.
  
- B. Description: Comply with UL 2024; flexible-type pathway, approved for **[plenum] [riser] [or] [general-use]** installation unless otherwise indicated.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.

#### 2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
  - 5. **<Insert manufacturer>**
  - 6. or approved equal.
  
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, **[Type 1] [Type 3R] [Type 4] [Type 12] <Insert type>** unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
  
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
  
- D. Wireway Covers: **[Hinged type] [Screw-cover type] [Flanged-and-gasketed type]** unless otherwise indicated.
  
- E. Finish: Manufacturer's standard enamel finish.

#### 2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Moulded Products, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Lamson & Sessions; Carlon Electrical Products.
  - 4. Niedax-Kleinhuis USA, Inc.
  - 5. <Insert manufacturer>
  - 6. or approved equal.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. [**Manufacturer's standard enamel finish in color selected by DEN Project Manager**] [**Prime coated, ready for field painting**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Mono-Systems, Inc.
    - b. Niedax-Kleinhuis USA, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.
    - e. **<Insert manufacturer>**
    - f. or approved equal.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by DEN Project Manager from **[manufacturer's standard] [custom]** colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems Division.
    - b. Lamson & Sessions; Carlon Electrical Products.
    - c. Mono-Systems, Inc.
    - d. Panduit Corp.
    - e. Wiremold / Legrand.
    - f. **<Insert manufacturer>**
    - g. or approved equal.

## 2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Adalet.
  2. Cooper Technologies Company; Cooper Crouse-Hinds.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. Hoffman; a Pentair company.
  6. Hubbell Incorporated; Killark Division.
  7. Lamson & Sessions; Carlon Electrical Products.
  8. Milbank Manufacturing Co.
  9. Molex; Woodhead Brand.
  10. Mono-Systems, Inc.
  11. O-Z/Gedney; a brand of EGS Electrical Group.
  12. RACO; a Hubbell company.
  13. Robroy Industries.
  14. Spring City Electrical Manufacturing Company.
  15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  16. Thomas & Betts Corporation.
  17. Wiremold / Legrand.
  18. **<Insert manufacturer>**



19. or approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
  2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
  3. Pull boxes shall be sufficiently large to accommodate the number of conduits in the run assuming a single cable of 51% fill in each of the raceways. All pull boxes shall be equipped with hinged covers.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, **[ferrous alloy]** **[aluminum]**, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
1. Material: **[Cast metal]** **[or]** **[sheet metal]**.
  2. Type: **[Fully adjustable]** **[Semi-adjustable]**.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, **[round]** **[rectangular]**.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, **[cast aluminum]** **[galvanized, cast iron]** with gasketed cover.
- J. Device Box Dimensions: **[4 inches square by 2-1/8 inches deep** (100 mm square by 60 mm deep)] **[4 inches by 2-1/8 inches by 2-1/8 inches deep** (100 mm by 60 mm by 60 mm deep)] **<Insert other dimension>**.
- K. Gangable boxes are allowed.
- L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, **[Type 1]** **[Type 3R]** **[Type 4]** **[Type 12]** **<Insert type>** with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's

- standard enamel.
- 2. Nonmetallic Enclosures:
  - a. Material: **[Plastic] [Fiberglass]**.
  - b. Finished inside with radio-frequency-resistant paint.
- 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

- 1. NEMA 250, **[Type 1] [Type 3R] [Type 12] <Insert type>**, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- 2. Hinged door in front cover with flush latch and concealed hinge.
- 3. Key latch to match panelboards.
- 4. Metal barriers to separate wiring of different systems and voltage.
- 5. Accessory feet where required for freestanding equipment.
- 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:

- 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
- 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. Comply with TIA-569-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. CDR Systems Corporation; Hubbell Power Systems.
  - d. NewBasis.
  - e. Oldcastle Precast, Inc.; Christy Concrete Products.
  - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - g. **<Insert manufacturer>**
  - h. or approved equal.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, [**"COMMUNICATIONS."**] <Insert **legend**>.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes [**12 Inches Wide by 24 Inches Long** (300 mm Wide by 600 mm Long)] <Insert **dimensions**> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of [**polymer concrete**] [**reinforced concrete**] [**cast iron**] [**hot-dip galvanized-steel diamond plate**] [**fiberglass**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. CDR Systems Corporation; Hubbell Power Systems.
  - d. NewBasis.
  - e. Nordic Fiberglass, Inc.
  - f. Oldcastle Precast, Inc.; Christy Concrete Products.
  - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - h. <Insert **manufacturer**>
  - i. or approved equal.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: [**Gray**] [**Green**].
4. Configuration: Designed for flush burial with [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, [**"COMMUNICATIONS."**] <Insert **legend**>.
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes [**12 Inches Wide by 24 Inches Long** (300 mm Wide by 600 mm Long)] <Insert **dimensions**> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: **[GRC] [IMC] [RNC, Type EPC-40-PVC] [RNC, Type EPC-80-PVC]**.
  2. **Concealed Conduit, Aboveground: [GRC] [IMC] [EMT] [RNC, Type EPC-40-PVC]**.
  3. Underground Conduit: RNC, **[Type EPC-40-PVC] [Type EPC-80-PVC], [direct buried] [concrete encased]**.
  4. Boxes and Enclosures, Aboveground: NEMA 250, **[Type 3R] [Type 4]**.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: **[EMT] [or] [RNC]**.
  2. Exposed, Not Subject to Severe Physical Damage: **[EMT] [RNC identified for such use]**.
  3. Exposed and Subject to Severe Physical Damage: **[GRC] [IMC]**. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums
    - e. **<Insert designations of applicable spaces or locations>**.
  4. Concealed in Ceilings and Interior Walls and Partitions: **[EMT] [RNC, Type EPC-40-PVC] [or] [innerduct]**.
  5. Damp or Wet Locations: **[GRC] [IMC]**.
  6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for

Environmental Air: [Plenum-type, optical-fiber-cable pathway] [Plenum-type, communications-cable pathway] [EMT] <Insert pathway type>.

7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: [Riser-type, optical-fiber-cable pathway] [Riser-type, communications-cable pathway] [EMT] <Insert pathway type>.
  8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: [General-use, optical-fiber-cable pathway] [Riser-type, optical-fiber-cable pathway] [Plenum-type, optical-fiber-cable pathway] [General-use, communications-cable pathway] [Riser-type, communications-cable pathway] [Plenum-type, communications-cable pathway] [EMT] .
  9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 [stainless steel] [nonmetallic] in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use [setscrew] [or] [compression], [steel] [cast-metal] fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds [120 deg F (49 deg C)] <Insert temperature>.
- H. Pull boxes, hand holes, and manholes installed in locations subject to vehicle traffic shall have a minimum rating of HS-20
- I. Pull boxes, hand holes and manholes installed in apron areas and taxiways shall be aircraft-rated.

### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for

types of pathways allowed in specific occupancies and number of floors.

- B. Keep pathways at least **6 inches** (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any pathway run. Support within **12 inches** (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within **12 inches** (300 mm) of enclosures to which attached.
- I. Communications room penetrations shall be made with a group of 4-inch metallic conduits equivalent in cross sectional area to the tray. Conduits shall be secured to both sides of the equipment room wall with unistrut and 4-inch unistrut clamps. Bonding bushings shall be provided on both sides of penetrating sleeves and bonded to tray/cable ladder on both sides. Firestop between conduits and wall.
- J. Pathways Embedded in Slabs:
  - 1. Run conduit larger than **1-inch** (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum **10-foot** (3-m) intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange pathways to keep a minimum of [**1 inch** (25 mm)] [**2 inches** (50 mm)] **<Insert dimension>** of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by DEN Project Manager for each specific location.
  - 5. Change from ENT to [**RNC, Type EPC-40-PVC,**] [**GRC**] [**or**] [**IMC**] before rising above floor.
- K. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits of **2-inch (53-mm)** trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- R. All conduit shall be verified after installation by pulling a mandrel through the conduit that is 80% of the internal diameter of the conduit. After completion of the mandrel test install one 3/4" wide woven aramid fiber pull tape in each conduit. Feed tape straight through pull boxes without breaking or splicing. Pull tape shall provide 2500 pounds of tensile strength and be marked with consecutive footage numbers at one-foot intervals. Permanently tie off tapes at both ends
- S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- T. Surface Pathways:
  - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  - 2. Install surface pathway with a minimum **2-inch (50-mm)** radius control at bend points.
  - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  - 1. **3/4-Inch (21-mm)** Trade Size and Smaller: Install pathways in maximum

- lengths of 50 feet (15 m).
  - 2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- V. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- W. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
- 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Y. Expansion-Joint Fittings:
- 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC[ and EMT] conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
  - 2. Expansion fittings shall not reduce the internal cross section of the associated conduit or duct.
  - 3. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: [125 deg F (70 deg C)] <Insert temperature> temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: [155 deg F (86 deg C)] <Insert temperature> temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: [125 deg F (70 deg C)] <Insert temperature> temperature change.
    - d. Attics: [135 deg F (75 deg C)] <Insert temperature> temperature change.
    - e. <Insert location and corresponding temperature change>.
  - 4. Install fitting(s) that provide expansion and contraction for at least



0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

5. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  6. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **[center]** **[top]** **[bottom]** of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Concrete-Encased Conduit:

1. Install all concrete-encased conduit in accordance with Section 260543 "Underground Ducts and Raceways for Electrical Systems."

#### B. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete for a minimum of **12 inches (300 mm)** on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately **12 inches (300 mm)** above direct-buried conduits, but a minimum of **6 inches (150 mm)** below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
8. Underground conduits containing non-metallic fiber cables shall be provided with a copper locate wire within each conduit. Locate wire shall be pulled within the conduit, outside the innerduct.

#### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch (25 mm)** above finished grade.
- D. Install handholes with bottom below frost line, **<Insert depth of frost line below grade at Project site>** below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and

conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

## **PART 4 - MEASUREMENT**

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

## **PART 5 - PAYMENT**

### 5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

**END OF SECTION 270528**

## SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Ladder cable trays.
2. Wire-basket cable trays.
3. Trough cable trays.
4. Fiberglass cable trays.

- B. Related Requirements:

1. Section 260536 "Cable Trays for Electrical Systems" for cable trays and accessories serving electrical systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

- B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

- C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
  2. Vertical and horizontal offsets and transitions.
  3. Clearances for access above and to side of cable trays.
  4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
  2. Component Importance Factor: **[1.5] [1.0]**.
  3. **<Insert requirements for Component Amplification Factor and Component Response Modification Factor>**.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces] <Insert temperature change>**.

## 2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
  - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

## 2.3 LADDER CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Chalfant Manufacturing Company.
  - 3. Cooper B-Line, Inc.
  - 4. Mono-Systems, Inc.
  - 5. MP Husky.
  - 6. Niedax-Kleinhuis USA, Inc.
  - 7. **<Insert manufacturer's name>**.
- C. Description:
  - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
  - 2. Rung Spacing: **[6 inches (150 mm)] [9 inches (225 mm)] [12 inches (300 mm)] [18 inches (450 mm)]** o.c.
  - 3. Radius-Fitting Rung Spacing: **9 inches (225 mm)** at center of tray's width.
  - 4. Minimum Cable-Bearing Surface for Rungs: **7/8-inch (22-mm)** width with radius edges.
  - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
  - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable

- load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: **[3 inches (75 mm)] [4 inches (100 mm)] [5 inches (125 mm)] [6 inches (150 mm)]**.
  8. Straight Section Lengths: **[10 feet (3 m)] [12 feet (3.6 m)] [20 feet (6 m)] [24 feet (7.4 m)]** except where shorter lengths are required to facilitate tray assembly.
  9. Width: **[6 inches (150 mm)] [9 inches (225 mm)] [12 inches (300 mm)] [18 inches (450 mm)] [24 inches (600 mm)] [30 inches (750 mm)] [36 inches (900 mm)]** unless otherwise indicated on Drawings.
  10. Fitting Minimum Radius: **[12 inches (300 mm)] [24 inches (600 mm)] [36 inches (900 mm)] [48 inches (1200 mm)]**.
  11. Class Designation: Comply with NEMA VE 1, **[Class 12B] [Class 12C] [Class 20B] [Class 20C]** <Insert designation>.
  12. Splicing Assemblies: Bolted type using serrated flange locknuts.
  13. Hardware and Fasteners: **[ASTM F 593 and ASTM F 594 stainless steel, Type 316] [Steel, zinc plated according to ASTM B 633]**.
  14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

## 2.4 WIRE-BASKET CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
  1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  2. Cablofil/Legrande.
  3. Chalfant Manufacturing Company.
  4. Cooper B-Line, Inc.
  5. Enduro Systems, Inc.
  6. Mono-Systems, Inc.
  7. MP Husky.
  8. Niedax-Kleinhuis USA, Inc.
  9. Snaketray.
  10. Wiremaid Products Division; Vutec Corporation.
  11. **<Insert manufacturer's name>**.
- C. Description:
  1. Configuration: Wires are formed into a standard **2-by-4-inch (50-by-100-mm)** wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
  2. Materials: High-strength-steel longitudinal wires with no bends.
  3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during



- manufacturing to maintain integrity of cables and installer safety.
4. Sizes:
    - a. Straight sections shall be furnished in standard **118-inch (3000-mm)** lengths.
    - b. Wire-Basket Depth: **1-inch (25-mm)** usable loading depth by [**4 inches (100 mm)**] [**12 inches (300 mm)**] wide.
    - c. Wire-Basket Depth: **2-inch (50-mm)** usable loading depth by [**4 inches (100 mm)**] [**6 inches (150 mm)**] [**8 inches (200 mm)**] [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] wide.
    - d. Wire-Basket Depth: **4-inch (100-mm)** usable loading depth by [**8 inches (200 mm)**] [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] wide.
    - e. Wire-Basket Depth: **6-inch (150-mm)** usable loading depth by [**8 inches (200 mm)**] [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] wide.
  5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
  6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
  7. Hardware and Fasteners: [**ASTM F 593 and ASTM F 594 stainless steel, Type 316**] [**Steel, zinc plated according to ASTM B 633**].

## 2.5 TROUGH CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
  1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  2. Chalfant Manufacturing Company.
  3. Cooper B-Line, Inc.
  4. Mono-Systems, Inc.
  5. MP Husky.
  6. Niedax-Kleinhuis USA, Inc.
  7. <Insert manufacturer's name>.
- C. Description:
  1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.
  2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of **6 inches**

- (150 mm) o.c. and have a minimum flat bearing surface of **2 inches (50 mm)**.
3. Radius-Fitting Rung Spacing: **9 inches (225 mm)** at center of tray's width.
  4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus **a200-lb (90-kg)** concentrated load, when tested according to NEMA VE 1.
  5. Minimum Usable Load Depth: [**3 inches (75 mm)**] [**4 inches (100 mm)**] [**5 inches (125 mm)**] [**6 inches (150 mm)**].
  6. Straight Section Lengths: [**10 feet (3 m)**] [**12 feet (3.6 m)**] [**20 feet (6 m)**] [**24 feet (7.4 m)**] except where shorter lengths are required to facilitate tray assembly.
  7. Width: [**6 inches (150 mm)**] [**9 inches (225 mm)**] [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] [**30 inches (750 mm)**] [**36 inches (900 mm)**] unless otherwise indicated on Drawings.
  8. Fitting Minimum Radius: [**12 inches (300 mm)**] [**24 inches (600 mm)**] [**36 inches (900 mm)**] [**48 inches (1200 mm)**].
  9. Class Designation: Comply with NEMA VE 1, [**Class 12B**] [**Class 12C**] [**Class 20B**] [**Class 20C**] <Insert designation>.
  10. Splicing Assemblies: Bolted type using serrated flange locknuts.
  11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
  12. Hardware and Fasteners: [**ASTM F 593 and ASTM F 594 stainless steel, Type 316**] [**Steel, zinc plated according to ASTM B 633**].

## 2.6 FIBERGLASS CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
  1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  2. Cooper B-Line, Inc.
  3. Enduro Systems, Inc.
  4. Mono-Systems, Inc.
  5. MP Husky.
  6. <Insert manufacturer's name>.
- C. Description:
  1. Configuration: Two longitudinal members with rounded edges and smooth surfaces, complying with NEMA FG 1.
  2. Materials: Straight section structural elements; side rails, rungs, and splice plates shall be pultruded from glass-fiber-reinforced [**polyester**] [**vinyl ester**] resin, complying with NEMA FG 1 and UL 568.
  3. Fasteners: Fiberglass-encapsulated, ASTM F 593 and ASTM F 594 stainless steel, Type 316. Design fasteners so that no metal is visible when fully

- assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.
4. Minimum Usable Load Depth: [1 inch (25 mm)] [2 inches (50 mm)] [3 inches (75 mm)] [5 inches (125 mm)] [7 inches (175 mm)] according to NEMA FG 1.
  5. Straight Section Lengths: [10 feet (3 m)] [20 feet (6 m)].
  6. Width: [6 inches (150 mm)] [9 inches (225 mm)] [12 inches (300 mm)] [18 inches (450 mm)] [24 inches (600 mm)] [30 inches (750 mm)] [36 inches (900 mm)] unless otherwise indicated on Drawings.
  7. Class Designation: Comply with NEMA VE 1, [Class 12B] [Class 12C] [Class 20B] [Class 20C] <Insert designation>.
  8. Temperature Rating: Reduce the load rating of tray exposed to temperatures above 75 deg F (24 deg C) according to Table 4-3, "Working Loads," in NEMA FG 1.
  9. Fitting Minimum Radius: [12 inches (300 mm)] [24 inches (600 mm)].
  10. Splicing Assemblies: Minimum four nuts and bolts per plate. Splice plates shall be furnished with straight sections and fittings.
  11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

## 2.7 MATERIALS AND FINISHES

### A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of [ASTM A 1011/A 1011M, SS, Grade 33] [ASTM A 1008/A 1008M, Grade 33, Type 2].
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.
  - a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
  - b. Hardware: [Galvanized, ASTM B 633] [Chromium-zinc plated, ASTM F 1136].
5. Finish: Electrogalvanized before fabrication.
  - a. Standard: Comply with ASTM B 633.
  - b. Hardware: Galvanized, ASTM B 633.
6. Finish: Hot-dip galvanized after fabrication.
  - a. Standard: Comply with ASTM A 123/A 123M, Class B2.
  - b. Hardware: [Chromium-zinc plated, ASTM F 1136] [Stainless steel, Type 316, ASTM F 593 and ASTM F 594].
7. Finish: [Epoxy-resin] [Powder-coat enamel] paint.
  - a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and

- corrosion-inhibiting treatment, with factory-applied powder-coat paint.
- b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
  - c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
  - d. Hardware: [**Chromium-zinc plated, ASTM F 1136**] [**Stainless steel, Type 316, ASTM F 593 and ASTM F 594**].
8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
  9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
  10. **<Insert finish>**.
- B. Aluminum:
1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and [**Alloy 5052-H32**] [**or**] [**Alloy 6061-T6**] according to ANSI H 35.1/H 35.1M for fabricated parts.
  2. Hardware: [**Chromium-zinc-plated steel, ASTM F 1136**] [**Stainless steel, Type 316, ASTM F 593 and ASTM F 594**].
  3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
- C. Stainless Steel:
1. Materials: Low-carbon, passivated, stainless steel, [**Type 304L**] [**or**] [**Type 316L**], ASTM F 593 and ASTM F 594.
  2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

## 2.8 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: [**Solid**] [**Louvered**] [**Ventilated-hat**] [**2-in-3 pitch**] type made of same materials and with same finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

## 2.9 WARNING SIGNS

- A. Lettering: [**1-1/2-inch- (40-mm-)**] **<Insert dimension>** high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical

Systems."

## 2.10 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to **[NEMA FG 1] [NEMA VE 1]**.

## PART 3 - EXECUTION

### 3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to **[NEMA FG 1] [NEMA VE 2]**.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure **[ and install seismic restraints]**.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of **200 lb (90 kg)**. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." **[ Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."]**
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to **[NEMA FG 1] [NEMA VE 2]**. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with **[center support hangers] [trapeze hangers]**

**[wall brackets].**

- N. Support **[center support hangers]** **[trapeze hangers]** for wire-basket trays with **[1/4-inch- (6-mm-)]** **[3/8-inch- (10-mm-)]** diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in **[NEMA FG 1]** **[NEMA VE 2]**. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- U. Install cable trays with enough workspace to permit access for installing cables.
- V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- Y. Install warning signs in visible locations on or near cable trays after cable tray installation.
- Z. Any cable trays which are installed exposed in public spaces shall be provided with solid bottom panels to conceal cabling.

### 3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed

for grounding purposes or with listed bonding jumpers.

- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

### 3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every **18 inches** (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than **72 inches** (1800 mm).
- E. Tie MI cables down every **36 inches** (900 mm) where required to provide a 2-hour fire rating and every **72 inches** (1800 mm) elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

### 3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections[ **with the assistance of a factory-authorized service representative**]:
  1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
  2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction

- conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
  4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
  5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
  6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
  7. Check for improperly sized or installed bonding jumpers.
  8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
  9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

### 3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.



## **SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. CONSTRUCTION WASTE MANAGEMENT

1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

**PART 2 - PRODUCTS**

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
  - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

G. Sleeves for Vertical (Backbone) Communications Pathways:

1. Vertical Communications Pathways are facilities used to distribute and support cable between MDF and IDF rooms. These pathways may include conduit, cable tray and sleeves between vertically aligned rooms.

2. Sleeves -Vertically aligned IDF and MDF rooms shall be linked with a series of 4-inch rigid metallic sleeves. Sleeves shall be attached to the wall above and below the floor slab with length of unistrut and appropriate clamp. Sleeves must not obstruct wall terminating space. All sleeves must be constructed in accordance with the National Electrical Code (NEC) and local fire codes. Sleeves shall be provided with a minimum of a 4 inch high chamfered curb as measured from the finished floor. All sleeves shall be fire safed in accordance with DEN standards.
3. The following table provides general guidelines for determining the number of 4 in. sleeves required, based on ANSI/EIA/TIAA-569:

| Total Square Feet Served | Qty of Sleeves |
|--------------------------|----------------|
| Up to 50,000             | 3              |
| 50,000 to 100,000        | 4              |
| 100,000 to 300,000       | 5-8            |
| 300,000 to 500,000       | 9-12           |

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
    - f. <Insert manufacturer>
    - g. or approved equal.
  2. Sealing Elements: [EPDM] [Nitrile (Buna N)] rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: [Carbon steel] [Plastic] [Stainless steel].
  4. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] [Stainless steel] of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Presealed Systems.
  - b. **<Insert manufacturer>**
  - c. or approved equal.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  2. Sealant shall have VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## 2.6 CABLE TRAY PENETRATIONS THROUGH FIRE RATED PARTITIONS

- A. Cable trays requiring penetration through fire rated partitions shall terminate on each side of the rated partition. Furnish and install STI EZ-PATH series re-enterable fire and smoke seal modules through rated partition with an area equal to the capacity of the cable tray. Modules shall be UL classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL 1479).

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide [1/4-inch (6.4-mm)] <Insert dimension> annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed[ or unless seismic criteria require different clearance].
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors [2 inches (50 mm)] <Insert dimension> above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
  - 3. 4" Conduits shall be secured to both sides of the wall with unistrut and 4-inch unistrut clamps.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

## PART 4 - MEASUREMENT

### 4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

## PART 5 - PAYMENT

### 5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 270544



**List of Proposed  
MWBE  
Bidders, Subcontractors,  
Suppliers, Manufacturers, or Brokers**

Office of Economic Development  
Division of Small Business Opportunity  
Denver International Airport  
Airport Office Building, Suite 7810  
8500 Pena Blvd  
Denver, CO 80249  
Phone: 303-342-2180 Fax: 303-342-2190  
E-mail: small.business@flydenver.com

|                   |           |              |          |
|-------------------|-----------|--------------|----------|
| <b>Contract #</b> | 201734681 | <b>Date:</b> | 10-18-17 |
|-------------------|-----------|--------------|----------|

|                       |                                            |
|-----------------------|--------------------------------------------|
| <b>Contract Name:</b> | On-CALL PASSENGER CONVEYANCE MODERNIZATION |
|-----------------------|--------------------------------------------|

The undersigned proposes to utilize the following MWBEs for the contract. All Listed firms are CURRENTLY certified by the City and County of Denver. Only the level of MWBE participation listed at the bid opening will count toward satisfaction of the contract goal. Only bona fide commissions may be counted for Brokers. MWBE prime proposers must detail their bid information below. Please copy and attach this page to list additional MWBE participation.

The undersigned bidder hereby certifies that the subcontractors and suppliers listed below have full knowledge that their names have been offered as subcontractors and suppliers for the work, and the bidder further certifies that the dollar amount of work to be performed by the MWBE was furnished to the bidder prior to the bid opening.

**Prime**

|                |                                                   |                 |               |
|----------------|---------------------------------------------------|-----------------|---------------|
| Business Name: | thyssenkrupp Elevator Corporation                 | Contact Person: | Stephan Smith |
| Address:       | 7367 S Revere Pkwy, Unit 2a, Centennial, CO 80112 | \$ Amount:      | 9,200,000.00  |
| Scope of Work: | Conveyance Modernization                          | % of Contract:  | 92            |

**Certified MWBE Prime**

|                |  |                 |  |
|----------------|--|-----------------|--|
| Business Name: |  | Contact Person: |  |
| Address:       |  | \$ Amount:      |  |
| Scope of Work: |  | % of Contract:  |  |

**Subcontractors, Suppliers, Manufacturers, or Brokers (check one box)**

|                |                                                           |          |                 |               |
|----------------|-----------------------------------------------------------|----------|-----------------|---------------|
| Subcontractor  | x                                                         | Supplier | Manufacturer    | Broker        |
| Business Name: | Key General Contractors                                   |          | Contact Person: | Kevin Murdock |
| Address:       | 1520 N. Union Blvd., Suite 202 Colorado Springs, CO 80909 |          | \$ Amount:      | \$0-\$800,000 |
| Scope of Work: | Electrical, fire alarm, mechanical, etc.                  |          | % of Contract:  | 0-8%          |

**Subcontractors, Suppliers, Manufacturers, or Brokers (check one box)**

|                |                                        |          |                 |               |
|----------------|----------------------------------------|----------|-----------------|---------------|
| Subcontractor  | x                                      | Supplier | Manufacturer    | Broker        |
| Business Name: | St. Andrew's Construction              |          | Contact Person: | Steve Wren    |
| Address:       | 12520 First Street, Eastlake, CO 80614 |          | \$ Amount:      | \$0-\$800,000 |
| Scope of Work: | Electrical, fire alarm                 |          | % of Contract:  | 0-8%          |

**Subcontractors, Suppliers, Manufacturers, or Brokers (check one box)**

|                |  |          |                 |        |
|----------------|--|----------|-----------------|--------|
| Subcontractor  |  | Supplier | Manufacturer    | Broker |
| Business Name: |  |          | Contact Person: |        |
| Address:       |  |          | \$ Amount:      |        |
| Scope of Work: |  |          | % of Contract:  |        |



## COMMITMENT TO MWBE PARTICIPATION

Office of Economic Development  
Division of Small Business Opportunity

Denver International Airport  
Airport Office Building, Suite 7810  
8500 Pena Blvd  
Denver, CO 80249  
Phone: 303-342-2180 Fax: 303-342-2190  
E-mail: small.business@flydenver.com

**The undersigned has satisfied the MWBE participant requirements in the following manner ( Please check the appropriate box):**

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                            |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------|
| <b>Contract #</b>                   | 201734681                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Contract Name:</b> | On-CALL PASSENGER CONVEYANCE MODERNIZATION |
| <input checked="" type="checkbox"/> | <p>The Bidder/Proposer is committed to the minimum advertised contract goal for MWBE utilization on the contract, and will submit Letters of Intent (LOI) for each subcontractor/subconsultant/supplier listed for participation in the Bid Forms as follows:</p> <p>Hard Bids: Three (3) business days after the bid opening<br/>Request for Proposals: With the proposal when due<br/>Compliance Plans: With each task/work order</p>                                                                                                                                                                                    |                       |                                            |
| <input type="checkbox"/>            | <p>The Bidder/Proposer is unable to meet the contract goal of _____ % MWBE, but is committed to a minimum of _____ % MWBE utilization on the contract. The Bidder/Proposer understands that they must submit a detailed statement of their Good Faith Effort (GFE) in accordance with DRMC Section 28-62 and 28-67 of Ordinance 85 Part 26 and must submit Letters of Intent for each MWBE listed for participation in the Bid Forms as follows:</p> <p>Hard Bids: Three (3) business days after the bid opening<br/>Request for Proposals: With the proposal when due<br/>Compliance Plans: With each task/work order</p> |                       |                                            |
| <input type="checkbox"/>            | <p>The Bidder/Proposer is a certified MWBE in good standing with the City and County of Denver and is committed to self-perform a minimum of _____ % of the work on the contract.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |                                            |

|                                                                          |             |                                                |                        |
|--------------------------------------------------------------------------|-------------|------------------------------------------------|------------------------|
| <b>Bidder/Proposer (Name of Firm):</b> thyssenkrupp Elevator Corporation |             |                                                |                        |
| <b>Signature (Firm's Representative):</b>                                |             |                                                | <b>Date:</b> 10-18-17  |
| <b>Title:</b> Regional President                                         |             |                                                |                        |
| <b>Address:</b> 7367 S. Revere Parkway, Unit 2a                          |             |                                                |                        |
| <b>City:</b> Centennial                                                  |             | <b>State:</b> CO                               | <b>Zip Code:</b> 80112 |
| <b>Phone:</b> 303-790-8566                                               | <b>Fax:</b> | <b>E-mail:</b> scott.stratton@thyssenkrupp.com |                        |



# **PROJECT MANUAL**



## **CONVEYANCE REPLACEMENT & MODERNIZATION**

**201734681**

# **PART I**

## **PROJECT REQUIREMENTS**

CITY & COUNTY OF DENVER  
DEPARTMENT OF AVIATION

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF AVIATION  
DENVER INTERNATIONAL AIRPORT  
CONVEYANCE REPLACEMENT & MODERNIZATION  
NO. 201734681**

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**INSTRUCTION TO PROPOSERS  
CITY AND COUNTY OF DENVER  
DEPARTMENT OF AVIATION**

**IB-12 QUANTITIES IN THE TASK ORDER FORM ENTITLED SCHEDULE OF PRICES AND QUANTITIES (PART 2 OF THE TASK ORDER FORMS)**

Items are designated as Lump Sum. Lump Sum prices are subject to negotiation and clarification by the City and County of Denver.

Payment to the Contractor will be based on the actual quantities of work performed, measured, and accepted or materials furnished in accordance with the Contract Documents.

Any of the estimated quantities of work and materials shown in the Task Order Forms may each be increased, decreased, or omitted as provided in the General Conditions, Special Conditions, or Technical Specifications.

**IB-13 TASK ORDER GUARANTEE; BONDS; INSURANCE**

As a guarantee of good faith on the part of the Contractor, each Task Order must be accompanied by a Task Order guarantee consisting of either a certified or cashier's check made payable without condition to the order of the City and County of Denver or a Task Order Payment and Performance bond written by an approved corporation surety in favor of the City and County of Denver. A Task Order Bond form for execution by the Contractor is supplied with each set of contract documents. IF A TASK ORDER BOND IS USED, IT MUST BE THE FORM OF TASK ORDER BOND SUPPLIED WITH THE CONTRACT DOCUMENTS.

**IB-16 SITE INSPECTION AND INVESTIGATIONS**

Prior to submitting an offer, the Contractor shall inspect the work site and its surroundings. A site visit may be undertaken at any time. For purposes of the contract, it shall be conclusively presumed that the Contractor has made a thorough inspection of the site and has waived the right to later claim extra payment or time extensions for conditions which would have been evident during an inspection.

Drawings and specifications, defining the work to be done, were prepared on the basis of interpretation by design professionals of information derived from investigations of the work site and site condition data provided by the City. Such information and data are subject to sampling errors, and the interpretation of the information and data depends to a degree on the judgment of the design professional. In view of this, the Contractor is invited to make additional investigations as the Contractor's judgment dictates the

need for such investigations.

Because the Task Order information cannot be guaranteed, the Contractor shall have assumed the risks attendant to successful performance of the work except for the risk of encountering differing site conditions which are defined in the General Conditions and shall never make claim for additional payments or time extensions on the grounds that the nature or amount of work to be done was not understood by the Contractor at the time of the RFP.

#### **IB-17 MINORITY/WOMEN BUSINESS ENTERPRISE (MBE/WBE) REQUIREMENTS**

This Contract is subject to all applicable provisions of Article III Divisions 1 and 3 of Chapter 28 of the DRMC (the "M/WBE Ordinance") and any Rules or Regulations promulgated pursuant thereto.

In accordance with the requirements of the M/WBE Ordinance, the Contractor is committed to, at a minimum, meet the participation goal of eight percent (8%) established for this Project, utilizing properly certified M/WBE subcontractors and suppliers. The Goal must be met with certified participants as set forth in Section 28-55, D.R.M.C. or through the demonstration of a sufficient good faith effort under Section 28-67, D.R.M.C. For compliance with good faith effort requirements under Section 28-62(b)(2), the percentage solicitation level required for this project is 100%. The Contractor identified in its Proposal MBE and/or WBE firms with which it intends to subcontract for services under this Agreement.

In accordance with Section 28-60(b) and Rules and Regulations promulgated pursuant thereto, the Director has authorized the utilization of a compliance plan to address the Goal for this Project. Therefore, at the time of proposal submittal, the contractor must include in their proposal only the Commitment Page which is included within this RFP. Letters of intent nor a compliance plan are required to be submitted with the proposal. The Contractor, when notified by DSBO, will prepare and present for review and approval of the Director a compliance plan for meeting the requirements of the M/WBE Ordinance. At a minimum, the proposed compliance plan shall comply with all requirements of the Rules and Regulations pertaining to such plans and shall be approved in writing by the Director. Upon such approval, the plan is hereby incorporated into this Contract by reference and may also be included as an Exhibit. Furthermore, the contractor will be required to submit letters of intent throughout the course of the project.

Without limiting the general applicability of the foregoing, the Contractor acknowledges its continuing duty, pursuant to Section 28-72 DRMC, to meet and maintain throughout the duration of this Contract its participation and compliance commitments and to ensure that all Subcontractors subject to the Ordinance also maintain such commitments and compliance. Failure to comply with these requirements may result, at the discretion of the Director of the Division of Small Business Opportunity ("DSBO"), in the imposition of sanctions against the

Contractor in accordance with Section 28-77, DRMC. Nothing contained in this Paragraph or in the referenced City ordinance shall negate the City's right to prior approval of Subcontractors, or substitutes therefore, under this Contract.

The proposer understands that if change orders or any other contract modifications are issued under the contract, the proposer shall have a continuing obligation to immediately inform DSBO in writing of any agreed upon increase or decrease in the scope of work of such contract, upon any of the bases discussed in Section 28-73 of the Ordinance, regardless of whether such increase or decrease in scope of work has been reduced to writing at the time of notification.

The proposer understands that if change orders or other contract modifications are issued under the contract, that include an increase in scope of work of a contract for construction, reconstruction, or remodeling, whether by amendment, change order, force account or otherwise which increases the dollar value of the contract, whether or not such change is within the scope of work designated for performance by an MBE/WBE at the time of contract award, such change orders or contract modification shall be immediately submitted to DSBO for notification purposes. Those amendments, change orders, force accounts or other contract modifications that involve a changed scope of work that cannot be performed by existing project subcontractors or by the contractor shall be subject to a goal for MBE/WBEs equal to the original goal on the contract which was included in the proposal. The contractor shall satisfy such goal with respect to such changed scope of work by soliciting new MBE/WBEs in accordance with Section 28-73 of the Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-75 (c) of the Ordinance. The contractor or consultant shall supply to the director the documentation described in Section 28-75 (c) of the Ordinance with respect to the increased dollar value of the contract.

All proposers are charged with knowledge of and are solely responsible for complying with each and every provision of the Ordinance in making a bid and, if awarded, in performing the work described in the Contract Documents. Failure to comply with these provisions could constitute cause for rejection of a bid or subject the selected contractor to sanctions set forth in the Ordinance. These instructions are intended only to generally assist the proposer in preparing and submitting a compliant bid. Should any questions arise regarding specific circumstances, proposers must consult the Ordinance or contact the Project's designated DSBO representative at (303) 342-2180.

### **IB-18 DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS**

The City and County of Denver encourages, but does not require, participation of independent partnerships with SBEs, MBEs, WBEs, and other business enterprises in supply chain activities, prime/subcontractor partnerships, and joint ventures for all contracts and purchase orders. Failure to participate or disclose this information will not impact the award of the contract or purchase order. Voluntary disclosure of such

independent partnerships to the City, if any, will be forwarded the DSBO for recording purposes only.

Using the form contained in the Bid Forms, entitled "Diversity and Inclusiveness in City Solicitations Information Request Form", please state whether you have a diversity and inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the Diversity and Inclusiveness in City Solicitations Information Request Form will provide an opportunity for City contractors/consultants to describe their own diversity and inclusiveness practices. Contractors/consultants are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor/consultant's current practices, if any. Diversity and Inclusiveness information provided by City contractors/consultants in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable information provided by or obtained from contractors/consultants will be in such reports.

#### **IB-20 SUBCONTRACTOR LISTS IN TASK ORDER**

The Contractor shall, on the forms included in the TNP Forms, identify each element of the work which the Contractor plans to subcontract, provide an estimate of the total cost to perform each element, and include the name and address of the proposed subcontractor.

#### **IB-21 PERMIT FEES**

The Contractor agrees to pay the permit fees associated with the construction of this project described in General Condition 317, and in the Special Conditions and Technical Specifications.

#### **IB-22 TAXES**

1. General. Contractor is referred to the General Conditions, G.C. 323, as to taxes to which they may be subject in performing the Work under this contract, including but not limited to sales and use taxes and the Denver Occupational Privilege Tax. The following instructions are to be considered along with the General Conditions and not in lieu of them.
2. Sales and Use Tax. Construction and building materials sold to contractors and subcontractors for use on structures, roads, streets, highways, and other public works owned by the City and County of Denver at Denver International Airport are exempt from state, RTD, and Cultural Facilities District sales and use taxes. However, such materials will be subject to sales and use taxes imposed by the City and County of Denver.



3. Exemption Certificates – Sales and Use Tax. It is responsibility of the Contractor and its subcontractors to apply to the Colorado Department of Revenue (“CDOR”) for a certificate, or certificates, of exemption indicating that their purchase of construction or building materials is for a public project, and to deliver to the City copies of such applications as soon as possible after approval by the CDOR. Contractors shall not include in their Task Order amounts the exempt State, RTD, and Cultural Facilities District Sales and Use Taxes.
4. Denver Occupational Privilege Tax. Any employee working for a contractor or a subcontractor who earns over \$500 working in Denver during a calendar month is subject to the payment of the Employee Occupational Privilege Tax. The Contractor and any subcontractor must pay the Business Occupational Privilege Tax for each of its employees who are subject to such tax.

### **IB-23 NONDISCRIMINATION IN THE AWARD OF CITY CONTRACTS**

It is the policy of the City and County of Denver to prohibit discrimination in the award of construction contracts and subcontracts for public improvements. Further, the City and County of Denver encourages contractors to utilize minority and women owned businesses and to divide the construction work into economically feasible units or segments to allow the most opportunity for subcontracting.

### **IB-24 MINORITY/WOMEN BUSINESS ENTERPRISE (MBE/WBE) REQUIREMENTS**

Divisions 1 and 3, Article III of Chapter 28 of the Denver Revised Municipal Code (Sections 28-31 to 28-36 and 28-52 to 28-90, D.R.M.C.) (the "Ordinance") apply to this Project and are incorporated into this Contract by reference. Generally, the Ordinance provides for the adoption of a good faith goals program, to be administered by the Division of Small Business Opportunity (DSBO), devised to provide increased bidding opportunities for Minority/Women Business Enterprises (MBE/WBEs). As such, each bidder must comply with the terms and conditions of the Ordinance in making its bid and, if awarded the Contract, in performing all Work thereunder. A bidder's failure to comply with the Ordinance, any Rules or Regulations promulgated pursuant thereto, or any additional requirement contained herein shall render the bid non-responsive and shall constitute cause for rejection. Failure by the contractor awarded the contract to comply with Ordinance requirements during the performance of the contract is a material breach of the contract, which may result in the termination of this contract, the imposition of sanctions or such other remedy, as deemed appropriate by DSBO. Copies of the Ordinance and its accompanying Rules and Regulations are available for the use and review of bidders from DSBO.

In order to comply with the bid requirements of the Ordinance, a bidder shall either meet the established project goal or, in the alternative, demonstrate that the bidder has made sufficient good faith efforts to meet the goal in accordance with the Ordinance. In preparing a bid to meet the established Project goal, bidders should consider the following instructions relating to compliance with the Ordinance:

1. Under the Ordinance, the Director of DSBO ("Director") is directed to establish project goals for expenditures on construction, reconstruction and remodeling work performed for the City and County of Denver. The specific goal for this project is stated in the Notice of Invitation for Bids bound herein.
2. In preparing its bid, each bidder shall list on the Bid Form pages entitled "List of Proposed Minority/Women Business Enterprise Bidders, Subcontractors, Suppliers, Manufacturers, Manufacturers' Representatives or Brokers" the name, address, work description/supply, committed level of participation and other required information for each MBE/WBE of any tier which the bidder intends to use in performing the work on this Project. **Only the MBE/WBEs identified and the precise levels of participation listed for each on the Bid Form page, at the time of bid opening, will be considered in determining whether the bidder has met the designated participation goal. Additional, revised or corrected participation submitted after bid opening will not be considered. MBE/WBE bidders may count self-performance or joint venture activity in meeting the MBE/WBE project goal, but only for the scope of work performed as a commercially useful function and at a percentage level the MBE/WBE will be performing itself.**
3. All MBE/WBEs listed on the Bid Form must be properly certified by the City on or before the date bids are opened in order to count towards meeting the designated goal. DSBO maintains an MBE/WBE Construction Directory ("Directory"), which is a current listing of MBE/WBEs that have been certified by the City. A copy of the Directory is available from DSBO, located at 201 W. Colfax, Dept. 907, Denver, Colorado, or on the website located at [www.denvergov.org/DSBO](http://www.denvergov.org/DSBO) and will also be made available at the pre-bid meeting. Bidders are encouraged to use the Directory to assist in locating MBE/WBEs for the work and supplies required on the Project. Bidders are reminded that changes may be made to the Directory at any time in accordance with the City's MBE/WBE Ordinance and procedures established to administer this program, and that a current copy of the Directory must always be used in preparing a bid. MBE/WBE certification or listing in the Directory is not a representation or warranty by the City as to the qualifications of any listed MBE/WBE.
4. In accordance with the provisions of the Ordinance, DSBO will evaluate each bid to determine the responsiveness of the bid to the requirements of the Ordinance. In determining whether a bidder's committed level of participation meets or exceeds the stated MBE/WBE goal, DSBO shall base its calculation of applicable amounts and percentages on the total base bid amount, not including any listed alternates, of each bid as follows:
  - a. The bid information provided by the agency will be used to determine the total base bid amount of each bid. Each bidder's total base bid amount will be multiplied by the MBE/WBE percentage established for the project to determine the exact dollar amount of required MBE/WBE

participation for the Project. This amount will then be compared against the exact dollar amounts for the MBE/WBEs committed for participation by the bidder. If the total dollar amount of participation listed meets or exceeds the established MBE/WBE dollar amount goal listed, then DSBO will determine that the goal has been met.

- b. In addition, DSBO will determine the exact commitment percentage for each listed MBE/WBE by dividing the dollar amount listed for each MBE/WBE by the total base bid dollar amount submitted by the bidder. These individual percentages, when totaled for all listed MBE/WBEs, will establish the total committed percentage level of MBE/WBE participation that the bidder must comply with during the life of the contract. In all cases, the committed percentage level of MBE/WBE participation must equal or exceed the assigned MBE/WBE goal for the Project.
- c. In providing the exact dollar amount of participation for each listed MBE/WBE, a bidder should take care never to round up in determining whether or not the total of these amounts meets or exceeds the established percentage goal. The goal must be met or exceeded by dollar amounts and percentages in order for DSBO to determine that the bidder has met or exceeded the applicable MBE/WBE goal.
- d. As previously mentioned, compliance with the MBE/WBE goal will be determined on the base bid alone. If a bid contains alternates, participation contained in any alternate will not count towards satisfaction of the Project goal. However, should any designated alternate be selected by the City for inclusion in the contract ultimately awarded, the MBE/WBE goal percentage level submitted at bid time, on the base bid, will also apply to the selected alternates and must be maintained for the life of the contract on the total contract amount, including any alternate work. Thus, even though such participation will not be considered in evaluating bids, bidders are urged to consider participation in preparing bids for designated alternates.
- e. On projects where force account or allowance bid items have been included, bidders must meet the MBE/WBE goal percentage based upon the total base bid, including all such items that are submitted to the City. However, when a force account or allowance is designated by the City to be either performed or purchased from a specific company, the bidder may back out the dollar amount of the force account or allowance from the total base bid and meet the MBE/WBE goal on the remaining reduced amount.
- f. On bids that, at the time of bid opening, are equal to or exceed Five Million Dollars (\$5,000,000.00), including any alternates that may be

selected, only sixty percent (60%) of the value of the commercially useful function performed by MBE/WBE suppliers shall count toward satisfaction of the Project goal. On Projects under Five Million Dollars (\$5,000,000.00) the value of the commercially useful function of MBE/WBE supplier(s) will count at a one hundred percent (100%) level. Manufacturers' representatives and packagers shall be counted in the same manner as brokers.

- g. **In utilizing the MBE/WBE participation of a Broker,** only the bona fide commissions earned by such Broker for its performance of a commercially useful function will count toward meeting the Project goals. The bidder must separate the bona fide brokerage commissions from the actual cost of the supplies or materials provided to determine the actual dollar amount of participation that can be counted towards meeting the goal.
5. On or before the third (3<sup>rd</sup>) working day after bid opening, all of the Bidders are required to submit an executed "MBE/WBE Letter of Intent" for each MBE/WBE listed on the Bid Form as a joint venture member, subcontractor, supplier, manufacturer, manufacturers' representative or broker of any tier. An MBE/WBE Bidder needs to submit a Letter of Intent for any portion of self-performed work to count towards MBE/WBE utilization. , Each Letter of Intent shall be submitted only for the MBE/WBEs listed at the time of bid opening, since this is the only participation that will be counted toward satisfaction of the project goal. A form for the MBE/WBE Letter of Intent is included with the Bid Form. The MBE/WBE Letter of Intent is a written communication from the Bidder to the City evidencing an understanding that the Bidder has or will enter into a contractual relationship with the MBE/WBE or that its subcontractor(s) and supplier(s), manufacturer(s), manufacturers' representative(s) and broker(s) will do so. Each MBE/WBE Letter of Intent shall be accompanied by a copy of the City and County of Denver's MBE/WBE certification letter for each proposed MBE/WBE identified at bid time. Bidders are urged to carefully review these Letters before submission to the City to ensure that they are properly completed and executed by the appropriate parties.

In preparing a bid to demonstrate a good faith effort, bidders should consider the following instructions relating to compliance with the Ordinance:

- 1. If any Bidder has not met the designated Project goal at the time the bids are opened or elects to present a good faith effort in lieu of or in addition to attempting to satisfy the designated Project goal, that Bidder shall submit, on or before the third (3<sup>rd</sup>) working day after the bid opening a detailed statement, with supporting documentation, setting forth its good faith efforts, made prior to bid opening, attempting to meet the established goal in accordance with Section 28-62 of the Ordinance. This statement shall address each of the items in Subsection (b) of that Section and any additional criteria that the DSBO

Director may establish by rule or regulation. A Bidder who fails to meet the Project goal and cannot show that it made a good faith effort to meet the goal shall be considered non-responsive.

2. The statement of good faith efforts shall include a specific response to each of the following as further defined by rule or regulation. A Bidder may include any additional information the Bidder believes may be relevant. Failure of a Bidder to show good faith efforts as to any one of the following items shall render its overall good faith showing insufficient and its bid non-responsive. Items (1) through (9) of Section 28-62, Subsection (b) of the Ordinance are set forth below:

- (1) The bidder or proposer must solicit through all reasonable and available means, the interest of all MBEs and WBEs certified in the scopes of work of the contract. The bidder or proposer must solicit the interest of such MBEs and WBEs within sufficient time, prior to the bid opening or date of final project-specific proposal in the case of a competitive selection process, to allow such MBEs and WBEs to respond to the solicitation. The bidder or proposer must determine with certainty if the MBEs and WBEs are interested by demonstrating appropriate steps to follow up initial solicitations.
- (2) The bidder or proposer must select portions of the work of the contract to be performed by MBEs and WBEs in order to increase the likelihood that the project goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate MBE and WBE participation as subcontractors or joint venturers, and for bidder or proposer self-performed work, as suppliers, manufacturers, manufacturer's representatives and brokers, all reasonably consistent with industry practice, even when the bidder or proposer would otherwise prefer to perform these work items with its own forces. The bidder or proposer must identify what portions of the contract will be self-performed and what portions of the contract will be opened to solicitation of bids, proposals and quotes from MBE and WBEs. All portions of the contract not self-performed must be solicited for MBE and WBE participation. The ability or desire of a bidder or proposer to perform the work of a contract with its own forces does not relieve the bidder or proposer of the responsibility to meet the project goal or demonstrate good faith efforts to do so.
- (3) The bidder or proposer, consistent with industry practice, must provide MBEs and WBEs at a clearly stated location with timely, adequate access to and information about the plans, specifications, and requirements of the contract, including bonding and insurance requirements, if any, to assist them in responding to a solicitation.

- (4) The bidder or proposer must negotiate in good faith with interested MBEs and WBEs and provide written documentation of such negotiation with each such MBE or WBE.
- (5) For each MBE or WBE which contacted the bidder or proposer or which the bidder or proposer contacted or attempted to subcontract or joint venture with, consistent with industry practice, the bidder or proposer must supply a statement giving the reasons why the bidder or proposer and the MBE or WBE did not succeed in negotiating a subcontracting, supplier, manufacturer, manufacturer's representative, broker or joint venture agreement, as applicable.
- (6) The bidder or proposer must provide verification that it rejected each non-utilized MBE and WBE because the MBE or WBE did not submit the lowest bid or it was not qualified. Such verification shall include a verified statement of the amounts of all bids received from potential or utilized subcontractors, suppliers, manufacturers, manufacturer's representatives, brokers or joint venturers on the contract, whether or not they are MBEs or WBEs. In making such a determination of not being qualified, the bidder or proposer shall be guided by the definition of qualified in section 28-54(42), but evidence of lack of qualification must be based on factors other than solely the amount of the MBEs or WBEs bid. For each MBE or WBE found not to be qualified by the bidder or proposer, the verification shall include a statement giving the bidder's or proposer's reasons for its conclusion. A bidder's or proposer's industry standing or group memberships may not be the cause of rejection of an MBE or WBE. A bidder or proposer may not reject an MBE or WBE as being unqualified without sound reasons based on a reasonably thorough investigation and assessment of the MBEs or WBEs capabilities and expertise.
- (7) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining bonding, lines of credit, or insurance as required by the City or by the bidder or proposer, provided that the bidder or proposer need not provide financial assistance toward this effort.
- (8) If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining necessary and competitively priced equipment, supplies, materials, or related assistance or services for performance under the contract, provided that the bidder or proposer need not provide financial assistance toward this effort.

- (9) The bidder or proposer must use the DSBO MBE/WBE directories to identify, recruit, and place MBEs and WBEs.

In accordance with the provisions of the Ordinance, the bidder agrees that it is committed to meeting either the MBE/WBE participation goal or the MBE/WBE participation set forth in its statement of good faith efforts. This commitment must be expressly indicated on the "Commitment to Minority/Women Business Enterprise Participation" form included with the Bid Form. This commitment includes the following understandings:

1. The bidder understands it must maintain MBE/WBE goals throughout the performance of the Contract pursuant to the requirements set out in D.R.M.C. 28-72.
2. The bidder understands that it must establish and maintain records and submit regular reports, as required, that will allow the City to assess progress in achieving the MBE/WBE participation goal.
3. The bidder understands that if change orders or any other contract modifications are issued under the contract, the bidder shall have a continuing obligation to immediately inform DSBO in writing of any agreed upon increase or decrease in the scope of work of such contract, upon any of the bases discussed in Section 28-73 of the Ordinance, regardless of whether such increase or decrease in scope of work has been reduced to writing at the time of notification.
4. The bidder understands that if change orders or other contract modifications are issued under the contract, that include an increase in scope of work of a contract for construction, reconstruction, or remodeling, whether by amendment, change order, force account or otherwise which increases the dollar value of the contract, whether or not such change is within the scope of work designated for performance by an MBE/WBE at the time of contract award, such change orders or contract modification shall be immediately submitted to DSBO for notification purposes. Those amendments, change orders, force accounts or other contract modifications that involve a changed scope of work that cannot be performed by existing project subcontractors or by the contractor shall be subject to a goal for MBE/WBEs equal to the original goal on the contract which was included in the bid. The contractor shall satisfy such goal with respect to such changed scope of work by soliciting new MBE/WBEs in accordance with Section 28-73 of the Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-75 (c) of the Ordinance. The contractor or consultant shall supply to the director the documentation described in Section 28-75 (c) of the Ordinance with respect to the increased dollar value of the contract.

All bidders are charged with knowledge of and are solely responsible for complying with each and every provision of the Ordinance in making a bid and, if awarded, in performing the work described in the Contract Documents. Failure to comply with these provisions could constitute

cause for rejection of a bid or subject the selected contractor to sanctions set forth in the Ordinance. These instructions are intended only to generally assist the bidder in preparing and submitting a compliant bid. Should any questions arise regarding specific circumstances, bidders must consult the Ordinance or contact the Project's designated DSBO representative at (303) 342-2180.

## **IB-25 DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS**

Each Bidder shall, as a condition of responsiveness to this solicitation, complete and return the “Diversity and Inclusiveness in City Solicitations Information Request Form” with their Task Order.

Using the “Diversity and Inclusiveness in City Solicitations Information Request Form” please state whether you have a diversity and inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the “Diversity and Inclusiveness in City Solicitations Information Request Form” will provide an opportunity for City contractors to describe their own diversity and inclusiveness practices. Contractors are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor’s current practices, if any.

Diversity and Inclusiveness information provided by City contractors in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable provided by or obtained from contractor’s will be in such reports.

In order for the agency or City to consider the Task Order or proposal, Contractors must complete the electronic version of the Diversity And Inclusiveness In City Solicitations Form then **print the completed form and include the hard copy as part of its Task Order documents. A proposal or response to a solicitation by a contractor/consultant that does not include this completed form shall be deemed non-responsive and rejected.** The form is found at: <https://fs7.formsite.com/CCDenver/form161/index.html>

The Diversity and Inclusiveness form is separate from the requirements established by DSBO, and must always be completed regardless of whether or not there are any goals assigned to the project.

## **IB-26 WAGE RATE REQUIREMENTS**

Pursuant to Section 20-76 of the Revised Municipal Code, the Contractor selected to perform this contract shall pay mechanics, laborers and workers employed directly upon the site of the work the full amounts accrued at the time of payment, computed wage rates not less than those shown on the current prevailing wage rate schedule included in the contract Task Order documents and any addenda thereto.



If the term of the contract extends for more than one year, the minimum City prevailing wage rates that contractors and subcontractors shall pay during any subsequent yearly period or portion thereof shall be the wage rates in effect on the yearly anniversary date of the contract which begins such subsequent period. In no event shall any increases in prevailing wages after the first anniversary of the contract result in any increased liability on the part of the City and the possibility and risk of any such increase is assumed by all contractors entering into such contract with the City.

#### **IB-27 CONSTRUCTION SCHEDULING**

The Contractor should refer to the General Conditions, Special Conditions, and Division I of the Technical Specifications for scheduling requirements for this contract.

#### **IB-28 EQUAL EMPLOYMENT OPPORTUNITY**

1. Article III, Division 2 of Chapter 28 applies to this contract. It is the policy of the City to provide equal opportunity in employment without regard to race, color, creed, sex, national origin, religion, marital status, or political opinion or affiliation. It is hereby deemed and declared to be for the public welfare and in the best interest of the City to require bidders, contractors and subcontractors soliciting and receiving, directly or indirectly, compensation from or through the City, for the performance of such contracts, to meet certain affirmative action and equal employment opportunity requirements. Additionally, contractors and subcontractors that hold any contracts which are federally-assisted shall be required to adhere to the Department of Labor's Contract Compliance program under Executive Order 11246 as defined in the regulations of the Secretary of Labor at 41 CFR Chapter 60-4.
2. After the Execution of the Contract, the Contractor shall submit the following to the Division of Small Business Opportunity:
  - (a) A statement that the Contractor shall implement the affirmative action steps set forth in the Rules and Regulations and Proposal Conditions of the Manager of Public Works pertaining to Equal Employment Opportunity, attached hereto, or the Contractor's affirmative action plan which meets these requirements, and
  - (b) A projection of its anticipated workforce for this contract on the attached "EEO Questionnaire." Both of these submittals are required before the Division of Small Business Opportunity will approve the Notice to Proceed.
3. The Contractor which is awarded this contract shall comply with the provisions and requirements, including the goals of minority and female participation and specific affirmative action steps, set forth in the Rules and Regulations and Proposal Conditions of the Manager of Public Works pertaining to Equal Employment Opportunity, as said rules and regulations may be amended or readopted from time

to time by the Manager of Public Works or the Director of the Division of Small Business Opportunity.

### **IB-29 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION**

The Contractor certifies, by submission of its Proposal or acceptance of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or involuntarily excluded from participation in any government contract by any Federal, State, or local government department or agency. It further agrees by submitting its Proposal that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the Contractor or any lower tier participant is unable to certify to this statement, it shall attach an explanation to its Task Order.

### **IB-30 INSURANCE REQUIREMENTS AND SAFETY MANUAL**

Contractor shall assure at Contract Execution that insurance requirements contained in the Contract Documents are met. In accordance with the provisions of General Contract Condition 1601, INSURANCE, the minimum insurance requirements for this Contract are set forth in the form **CITY AND COUNTY OF DENVER INSURANCE CERTIFICATE** contained in the Special Conditions Section of the Contract Documents. Contractors are urged to consider in preparing a Task Order hereunder that the Contractor and all subcontractors performing Work on the Project must comply with each condition, requirement or specification set forth in the form certificate, unless such requirements are specifically accepted in writing by the City's Risk Management Administrator. The Contractor must either include all subcontractors performing work hereunder as insureds under each required policy or furnish a separate certificate (on the form certificate provided) for each subcontractor.

All certificates required by this Contract shall be sent directly to Denver International Airport, Business Management Services, via the following email address: [ContractAdminInvoices@flydenver.com](mailto:ContractAdminInvoices@flydenver.com) The City project/Contract number and project description shall be noted on the certificate of insurance. The City reserves the right to require complete, certified copies of all insurance policies required by this Contract at any time.

### **IB-31 INVOICING**

The Contractor recognizes and agrees that it shall be required to use the Textura® Construction Payment Management System (CPM System) for this Project.

All fees associated with the CPM System are to be paid by the Contractor prior to billings for any work performed (the "Textura Fee"). **The Textura fee shall be included as a line item in the Contractors Schedule of Values per Task Order.**

During the negotiation phase the City will work with Textura to calculate the Textura

fee as a percentage of the sub-total of all other line items. The City will provide the Textura Fee amount to the Contractor, who will then pay this amount to Textura directly. The Textura Fee should be included on a Contractors pay application to the City and the City will reimburse the Contractor as a pass-through expense for the Textura Fee with no mark-up.

The attached Textura Fee Schedule, included in the Proposal documents, is only to be used as a reference.

Effective January 2018, Textura will be moving to a flat fee schedule as attached. Fees paid by Prime with no mark up, and subsequently reimbursed by the City, will no longer be calculated as a percentage of a task/contract amount but will instead be a flat amount.

## **IB-32 PROJECT CONTROLS REQUIREMENTS**

The Contractor will be required to use the designated Project Management Information System (PMIS) as set forth in the Technical Specifications. The PMIS is Airport Infrastructure Management's tool for project and information management, data analysis and document control. Denver International Airport will be responsible for providing the licensing and training for PMIS.

**EEO QUESTIONNAIRE**  
**Contract No.: 201734681**

1. Name of Business: \_\_\_\_\_
2. Address: \_\_\_\_\_
3. City, State, Zip Code: \_\_\_\_\_
4. Telephone Number: (\_\_\_\_) \_\_\_\_\_
5. Name and title of your firm's EEO Contact: \_\_\_\_\_
6. Are you an affiliate or a subsidiary of another business organization (branches, etc.)?  
 Yes  No
7. Type of business you are engaged in: \_\_\_\_\_
8. Does the organization have a procedure for resolving discrimination complaints?  
 Yes  No
9. Has your firm been charged with discrimination within the past eighteen (18) months?  
 Yes  No
10. Is your firm required to submit an EEO-1 annually to the EEOC?  
 Yes  No
11. Are you now working or have you worked on a City and County of Denver contract during the past twelve (12) months?  Yes  No  
If yes, complete the following information:

| <u>Type of Contract</u> | <u>Contract Number</u> | <u>Total Cost of Each Contract</u> |
|-------------------------|------------------------|------------------------------------|
| _____                   | _____                  | _____                              |
| _____                   | _____                  | _____                              |
| _____                   | _____                  | _____                              |
| _____                   | _____                  | _____                              |

(You may use additional sheets if necessary)

**PROJECTION OF ANTICIPATED WORKFORCE**  
**Contract No. 201734681**

12. List the number of anticipated new employees needed by the contractor to perform this contract by trade/craft positions.

**ANTICIPATED NUMBER OF NEW EMPLOYEES FOR THIS CONTRACT**

| Trade<br>Craft | Estimated<br>Total<br>Manpower | Estimated<br>Total<br>Hours | Number of<br>Employees<br>Minority/Female | Total Estimated<br>Employees<br>Minority/Female |
|----------------|--------------------------------|-----------------------------|-------------------------------------------|-------------------------------------------------|
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |

13. What is the anticipated number of employees from the Contractor's current work force to be utilized to perform this contract? \_\_\_\_\_

14. Estimate manpower utilization for the project below:

**ESTIMATE OF MANPOWER UTILIZATION**

| Trade<br>Craft | Estimated<br>Total<br>Manpower | Estimated<br>Total<br>Hours | Number of<br>Employees<br>Minority/Female | Total Estimated<br>Employees<br>Minority/Female |
|----------------|--------------------------------|-----------------------------|-------------------------------------------|-------------------------------------------------|
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |
| _____          | _____                          | _____                       | _____                                     | _____                                           |

15. Will the estimated total manpower (anticipated new hires and current staff to be utilized on this contract) meet the City's minority employment and female employment goals?

Yes  No

# DIVERSITY AND INCLUSIVENESS IN CITY SOLICITATIONS

In order for the agency or City to consider the Task Order or proposal, Contractors must complete the electronic version of the Diversity And Inclusiveness In City Solicitations Form then **print the completed form and include the hard copy as part of its Task Order documents. A proposal or response to a solicitation by a contractor/consultant that does not include this completed form shall be deemed non-responsive and rejected.** The form is found at: <https://fs7.formsite.com/CCDenver/form161/index.html>

Using the form found in link listed above, please state whether you have a Diversity and Inclusiveness program for employment and retention, procurement and supply chain activities, or customer service and provide the additional information requested on the form. The information provided on the Diversity and Inclusiveness in City Solicitations Information Request Form will provide an opportunity for City contractors/consultants to describe their own diversity and inclusiveness practices. Contractors/consultants are not expected to conduct intrusive examinations of its employees, managers, or business partners in order to describe diversity and inclusiveness measures. Rather, the City simply seeks a description of the contractor/consultant's current practices, if any. Diversity and Inclusiveness information provided by City contractors/consultants in response to City solicitations for services or goods will be collated, analyzed, and made available in reports consistent with City Executive Order No. 101. However, no personally identifiable information provided by or obtained from contractors/consultants will be in such reports.

**Insert the completed hard copy of the Diversity And Inclusiveness  
In City Solicitations Form immediately following this page.**

**A SIGNED HARD COPY OF THE COMPLETED FORM MUST  
BE INCLUDED IN YOUR TASK ORDER RESPONSE**

Contractor \_\_\_\_\_

**DENVER INTERNATIONAL AIRPORT**

**Conveyance Replacement & Modernization  
Contract No.201734681**

**Task Order Data Forms  
EQUAL OPPORTUNITY REPORT STATEMENT**

Each Contractor shall complete and sign the Equal Opportunity Report Statement. A Task Order may be considered unresponsive and may be rejected, in the Owner's sole discretion, if the Contractor fails to provide the fully executed Statement or fails to furnish required data. The Contractor shall also, prior to award, furnish such other pertinent information regarding its own employment policies and practices as well as those of its proposed subcontractors as the FAA, the Owner, or the Executive Vice Chairman of the President's Committee may require.

The Contractor shall furnish similar Statements executed by each of its first-tier and second-tier subcontractors and shall obtain similar compliance by such subcontractors, before awarding subcontracts. No subcontract shall be awarded to any non-complying subcontractor.

Equal Opportunity Report Statement  
as Required in 41 CFR 60-1.7(b)

The Contractor shall complete the following statements by checking the appropriate blanks. Failure to complete these blanks may be grounds for rejection of the Proposal:

1. The Contractor has \_\_\_ has not \_\_\_ developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-1.40 and 41 CFR 60-2.
2. The Contractor has \_\_\_ has not \_\_\_ participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 11246, as amended.
3. The Contractor has \_\_\_ has not \_\_\_ filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).
4. The Contractor does \_\_\_ does not \_\_\_ employ fifty or more employees.

Dated: \_\_\_\_\_

\_\_\_\_\_  
(Name of Contractor)

By: \_\_\_\_\_

Title: \_\_\_\_\_

Contractor \_\_\_\_\_

**DENVER INTERNATIONAL AIRPORT**

**Conveyance Replacement & Modernization  
Contract No.201734681  
Task Order Data Forms**

**CERTIFICATION OF NON-SEGREGATED FACILITIES  
(Must be completed and submitted with the Contract)**

The Contractor certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The Contractor certifies further that it will not maintain or provide for its employees segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location under its control, where segregated facilities are maintained. The Contractor agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or any other reason. The Contractor agrees that (except where it has obtained identical certification from proposed subcontractors for specific time period) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the equal opportunity clause, and that it will retain such certification in its files.

DATED: \_\_\_\_\_

\_\_\_\_\_  
(Name of Contractor)

By: \_\_\_\_\_

Title: \_\_\_\_\_



## TEXTURA - CPM FEES - DENVER / DEN

|          | PROJECT SIZE                         | FEE (% OF TASK ORDER) |
|----------|--------------------------------------|-----------------------|
| <b>A</b> | <b>&lt; \$1,000,000</b>              | <b>0.0022</b>         |
| <b>B</b> | <b>\$1,000,001 - \$5,000,000</b>     | <b>0.0017</b>         |
| <b>C</b> | <b>\$5,000,001 - \$20,000,000</b>    | <b>0.0012</b>         |
| <b>D</b> | <b>\$20,000,001 - \$50,000,000</b>   | <b>0.0010</b>         |
| <b>E</b> | <b>\$50,000,001 - \$100,000,000</b>  | <b>0.0008</b>         |
| <b>F</b> | <b>\$100,000,001 - \$500,000,000</b> | <b>0.0005</b>         |
| <b>G</b> | <b>&gt; \$500,000,000</b>            | <b>*</b>              |

\* CONTACT TEXTURA FOR PROGRAMING PRICING

**EXAMPLES:**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                |                        |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------|-----------------|--|-----------------------|--------|--|-------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------|-----------------|--|---------------------------|--------------|--|--------------------|-------------|--|--------------------------------|------------------------|
| <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>A</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$978,256.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0022</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$2,152.16</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;"><b>\$980,408.</b></td> </tr> </table>     | <b>A</b>                       | Sub Total              | \$978,256.00    |  | Fee (% of Task Order) | 0.0022 |  | Textura Fee | \$2,152.16  |                                                                                                                                                                                                                                                                                                                                                                                                                 | Total (Sub Total +Textura Fee) | <b>\$980,408.</b>   | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>D</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$35,078,342.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0010</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$35,078.34</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;"><b>\$35,113,420.34</b></td> </tr> </table>            | <b>D</b> | Sub Total         | \$35,078,342.00 |  | Fee (% of Task Order)     | 0.0010       |  | Textura Fee        | \$35,078.34 |  | Total (Sub Total +Textura Fee) | <b>\$35,113,420.34</b> |
| <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$978,256.00           |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Fee (% of Task Order)          | 0.0022                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Textura Fee                    | \$2,152.16             |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total (Sub Total +Textura Fee) | <b>\$980,408.</b>      |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
| <b>D</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$35,078,342.00        |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Fee (% of Task Order)          | 0.0010                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Textura Fee                    | \$35,078.34            |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total (Sub Total +Textura Fee) | <b>\$35,113,420.34</b> |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
| <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>B</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$4,000,946.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0017</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$6,801.61</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;"><b>\$4,007,747.</b></td> </tr> </table> | <b>B</b>                       | Sub Total              | \$4,000,946.00  |  | Fee (% of Task Order) | 0.0017 |  | Textura Fee | \$6,801.61  |                                                                                                                                                                                                                                                                                                                                                                                                                 | Total (Sub Total +Textura Fee) | <b>\$4,007,747.</b> | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>E</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$85,406,871.00</td> </tr> <tr> <td></td> <td>TotaFee (% of Task Order)</td> <td style="text-align: right;">0.0008</td> </tr> <tr> <td></td> <td>Order) Textura Fee</td> <td style="text-align: right;">\$68,325.50</td> </tr> <tr> <td></td> <td style="border-top: 1px solid black;">Total (Sub Total +Textura Fee)</td> <td style="text-align: right; border-top: 1px solid black;"><b>\$85,475,196.50</b></td> </tr> </table> | <b>E</b> | Sub Total         | \$85,406,871.00 |  | TotaFee (% of Task Order) | 0.0008       |  | Order) Textura Fee | \$68,325.50 |  | Total (Sub Total +Textura Fee) | <b>\$85,475,196.50</b> |
| <b>B</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$4,000,946.00         |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Fee (% of Task Order)          | 0.0017                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Textura Fee                    | \$6,801.61             |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total (Sub Total +Textura Fee) | <b>\$4,007,747.</b>    |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
| <b>E</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$85,406,871.00        |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TotaFee (% of Task Order)      | 0.0008                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Order) Textura Fee             | \$68,325.50            |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total (Sub Total +Textura Fee) | <b>\$85,475,196.50</b> |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
| <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>C</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$19,000,946.00</td> </tr> <tr> <td></td> <td>Fee (% of Task Order)</td> <td style="text-align: right;">0.0012</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$22,801.14</td> </tr> </table>                                                                                                                                                                                      | <b>C</b>                       | Sub Total              | \$19,000,946.00 |  | Fee (% of Task Order) | 0.0012 |  | Textura Fee | \$22,801.14 | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"><b>F</b></td> <td style="width: 30%;">Sub Total</td> <td style="width: 20%; text-align: right;">\$428,335,078.00</td> </tr> <tr> <td></td> <td>(% of Task Order)</td> <td style="text-align: right;">0.0005</td> </tr> <tr> <td></td> <td>Textura Fee</td> <td style="text-align: right;">\$214,167.54</td> </tr> </table> | <b>F</b>                       | Sub Total           | \$428,335,078.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          | (% of Task Order) | 0.0005          |  | Textura Fee               | \$214,167.54 |  |                    |             |  |                                |                        |
| <b>C</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$19,000,946.00        |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Fee (% of Task Order)          | 0.0012                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Textura Fee                    | \$22,801.14            |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
| <b>F</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sub Total                      | \$428,335,078.00       |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | (% of Task Order)              | 0.0005                 |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Textura Fee                    | \$214,167.54           |                 |  |                       |        |  |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                   |                 |  |                           |              |  |                    |             |  |                                |                        |

|                                       |                        |                                       |                         |
|---------------------------------------|------------------------|---------------------------------------|-------------------------|
| <b>Total (Sub Total +Textura Fee)</b> | <b>\$19,023,747.14</b> | <b>Total (Sub Total +Textura Fee)</b> | <b>\$428,549,245.54</b> |
|---------------------------------------|------------------------|---------------------------------------|-------------------------|

# W-9

**Please complete the Request for Taxpayer Identification Number and Certification (Form W-9) and submit with your Proposal. These pages are not included in the page numbering of this contract document.**

# **DSBO FORMS**

**The DSBO forms which apply to this contract are contained in the pages immediately following this page. These pages are not included in the numbering of this contract document.**

# **PREVAILING WAGES**

# **CONTRACT**

**The contract is contained in the pages immediately following this page  
which include the following attachments:**

**These pages are not included in the page numbering of this contract document.**

## CONTRACT

**THIS CONTRACT**, made and entered into as of the date indicated on the City signature page below, by and between the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado, hereinafter referred to as the "**CITY**", and **THYSSENKRUPP ELEVATOR CORPORATION**, a corporation organized and existing under and by virtue of the laws of the State of Georgia and authorized to work in Colorado, hereinafter referred to as the "**CONTRACTOR**";

## WITNESSETH

**WHEREAS**, the City, for at least three (3) consecutive days, advertised that sealed proposals would be received for furnishing all labor, tools, supplies, equipment, materials and everything necessary and required for the construction and installation of task orders issued under Contract No. **2017346810, ON-CALL CONSTRUCTION SERVICES 2017**, Denver International Airport; and

**WHEREAS**, proposals to said advertisement have been received by the Chief Executive Officer Department of Aviation, who has recommended that a contract for said work be made and entered into with the above named Contractor who was the best, responsive, qualified proposer therefore; and

**WHEREAS**, said Contractor is now willing and able to perform all of said work in accordance with the Contract Documents and its proposal;

**NOW, THEREFORE**, for and in consideration of the compensation to be paid the Contractor, the mutual agreements hereinafter contained, and subject to the terms hereinafter stated, it is mutually agreed as follows:

**ARTICLE I - CONTRACT DOCUMENTS**: It is agreed by the parties hereto that the following list of instruments, drawings and documents which are attached hereto and bound herewith or incorporated herein by reference constitute and shall be referred to either as the Contract Documents or the Contract, and all of said instruments, drawings and documents taken together as a whole constitute the Contract between the parties hereto, and they are as fully a part of this agreement as if they were set out verbatim and in full herein:

- Notice to Apparent Selected Proposer (incorporated by reference)
- Contract
- Exhibit A – Compliance Plan
- Exhibit B - Payment & Performance Bond
- Exhibit C - Notice to Proceed
- Exhibit D - Form of Final Receipt
- Exhibit E - Construction Contract General Conditions (table of contents attached)
- Exhibit F - Special Conditions
- Exhibit G - Prevailing Wage Schedules
- Exhibit H - Insurance requirements

Exhibit I - Equal Employment Opportunity Provisions  
Technical Specifications (to be provided and incorporated per task order)  
Contract Drawings (to be provided and incorporated per task order)  
Approved Shop Drawings (to be provided and incorporated per task order)  
Approved Task Orders  
Approved Task Order Directives  
Approved Change Orders  
Approved Change Order Directives  
Task Notice for Proposal

**ARTICLE II - SCOPE OF WORK:** The Contractor agrees to and shall furnish all labor and tools, supplies, equipment, superintendence, materials and everything necessary for and required to do, perform and complete all of the work described, drawn, set forth, shown and included in said Contract Documents.

**ARTICLE III - TERMS OF PERFORMANCE:** The Contractor agrees to begin the performance of the work required under this Contract within ten (10) days after being notified to commence work by the Senior Vice President – Airport Infrastructure Maintenance (“SVP”) and agrees to fully complete the Work in its entirety within the time frame established for each Task. The entire contract shall be complete no later than 1825 consecutive calendar days from the date of said Notice to Proceed. This period of performance is also referred to as Contract Time. The Contractor is not authorized to commence work prior to its receipt of the Notice to Proceed.

**ARTICLE IV - LIQUIDATED DAMAGES:** It is understood and agreed by and between the City and the Contractor that, if the Contractor fails to achieve Substantial Completion of the Work within the Contract Time or fails to substantially complete the Work described in a Milestone Area within the time set forth in the Special Conditions or causes Disruptions as set forth in the Special Conditions, the City will suffer substantial damages, which damages would be difficult to accurately determine. The parties hereto have considered the possible elements of damages and have agreed that the amount of liquidated damages for the Contractor's failure to substantially complete the work within the Contract Time or to substantially complete the work described in Milestone Areas within the time set forth in the Special Conditions or causes Disruptions as set forth in the Special Conditions shall be those amounts listed in the Special Conditions. If the Contractor shall fail to pay such liquidated damages promptly upon demand therefor, the Surety on its Performance Bond and Payment Bond shall pay such damages. Also, the City may withhold all, or any part of, such liquidated damages from any payment due the Contractor. Additional provisions relating to liquidated damages are set forth in the Construction Contract General Conditions and Special Conditions.

**ARTICLE V - TERMS OF PAYMENT:** The City agrees to pay the Contractor for the performance and completion of all of the Work required under each authorized Task Order, in accordance with the Contract Documents. In no event, however, shall the total amount of compensation paid to the Contractor by the City exceed the maximum contract amount specified herein.



The maximum amount to be paid by the City to the Contractor for satisfactory completion of all Task Orders authorized by the City and performed by the Contractor under this Contract shall in no event exceed **Ten Million Dollars and Zero Cents (\$10,000,000.00)**, unless the Contract is modified to increase said amount by a duly authorized, written contract amendment mutually agreeable to and executed by the parties hereto.

Payments will be made to the Contractor in accordance with the City's Prompt Payment Ordinance, D.R.M.C., Section 20-107, et. seq., subject to the maximum contract amount stated above. Contractor agrees that interest and late fees shall be payable by the City hereunder only to the extent authorized and provided for in the City's Prompt Payment Ordinance.

Payment hereunder will be in accordance with the provisions of the Contract Documents, including Title 9 of the General Conditions, and will be made solely and exclusively from funds appropriated and otherwise lawfully made available for the purposes of this Contract from the City and County of Denver Airport System, Operations and Maintenance and Capital Improvement funds. The City has no obligation to make payments from any other fund or source or to make additional appropriations or allocations to such fund to satisfy such costs or other obligations.

#### **ARTICLE VI - INSPECTION AND ACCEPTANCE:**

Contractor shall perform all services in accordance with the standard of care exercised by highly competent vendors who perform like or similar services. City may inspect all goods/services prior to acceptance. Payment does not constitute acceptance. Contractor shall bear the cost of any inspection/testing that reveal goods/services that are defective or do not meet specifications. City's failure to accept or reject goods/services shall not relieve Contractor from its responsibility for such goods/services that are defective or do not meet specifications nor impose liability on City for such goods/services. If any part of the goods/services are not acceptable to City, City may, in addition to any other rights it may have at law or in equity: (1) make a warranty claim; (2) repair and/or replace the goods or substitute other services at Contractor's expense; or (3) reject and return the goods at Contractor's cost and/or reject the services at Contractor's expense for full credit. Any rejected goods/services are not to be replaced without written authorization from City, and any such replacement shall be on the same terms and conditions contained in this Agreement.

**ARTICLE VII - DISPUTES:** It is agreed and understood by the parties hereto that disputes regarding this contract shall be resolved by administrative hearing under procedures described in Revised Municipal Code Section 5-17.

**ARTICLE VIII - RISK OF LOSS:** Contractor shall bear the risk of loss, injury or destruction of goods prior to delivery to City. Loss, injury or destruction shall not release Contractor from any obligation hereunder.

**ARTICLE IX - WARRANTY:** Contractor warrants and guarantees to City that all goods furnished under this Agreement are free from defects in workmanship and materials, are merchantable, and fit for the purposes for which they are to be used. For any goods furnished under this Agreement which become defective within twelve (12) months (unless otherwise specified) after date of receipt and final acceptance by City, Contractor shall, at City's election and to City's satisfaction, 1. Remedy any and all defects or replace the defective goods at no expense to City within seven (7) days of receipt of the defective goods or 2. Accept the defective goods for full credit and payment of any return shipping charges or 3. Accept a Contractor provided written plan of repair commencement with time frames which would require approval by the City's Authorized Representative. For one (1) year following installation and final acceptance by the City, Contractor shall furnish all spare parts necessary (at no additional cost) for the repair and maintenance of the purchased conveyance unit. Contractor shall provide a spare parts list that must be approved by the City. The cost of any spare parts required shall be included in the base bid price. Contractor shall also be required to make periodic on-site evaluations/adjustment or repairs to the units during the 12 months after final acceptance by the City. Evaluation dates will be mutually agreed upon by the Parties.

**ARTICLE X - CONTRACT BINDING:** It is agreed that this Contract shall be binding on and inure to the benefit of the parties hereto, their heirs, executors, administrators, assigns and successors.

**ARTICLE XI - SEVERABILITY:** If any part, portion or provision of this Contract shall be found or declared null, void, or unenforceable for any reason whatsoever by any court of competent jurisdiction or any governmental agency having authority thereover, only such part, portion, or provision shall be affected thereby and all other parts, portions and provisions of this Contract shall remain in full force and effect.

**ARTICLE X - ASSIGNMENT:** The Contractor shall not assign the whole or any part of its duties, rights, and interests in this Contract without first obtaining the written consent of the Manager.

**ARTICLE XII - APPROVALS:** In the event this Contract calls for the payment by the City of Five Million Dollars (\$5,000,000.00) or more, approval by the Board of Councilmen of the City and County of Denver, acting by Ordinance in accordance with Section 3.2.6 of the Charter of the City and County of Denver, is and shall be an express condition precedent to the lawful and binding execution and performance of this Contract.

**ARTICLE XIII - JOINT VENTURE:** If the Contractor is a Joint Venture, the partners to the Joint Venture shall be jointly and severally liable to the City for the performance of all duties and obligations of the Contractor which are set forth in the Contract.

**ARTICLE XIV - NO DISCRIMINATION IN EMPLOYMENT:** In connection with the performance of work under this Contract, the Contractor agrees not to refuse to hire, discharge, promote or demote, or to discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, gender, age, military status, sexual orientation, gender variance, marital status, or physical or mental disability; and the Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

**ARTICLE XV - WAIVER OF CRS 13-20-801, et seq.:** Notwithstanding any other provision of this Contract, the Contractor specifically waives all of the provisions of Colorado Revised Statutes §§ 13-20-801 – 80 as they may relate to the Contractor’s performance under this Contract.

**ARTICLE XVI - COORDINATION OF SERVICES:** The Contractor agrees to perform its work under this Contract in accordance with the operational requirements of DIA, and all work and movement of personnel or equipment on areas included within the DIA site shall be subject to the regulations and restrictions established by the City or its authorized agents.

**ARTICLE XVII - COMPLIANCE WITH ALL LAWS AND REGULATIONS:** All of the work performed under this Contract by the Consultant shall comply with all applicable laws, rules, regulations and codes of the United States and the State of Colorado, and with the charter, ordinances and rules and regulations of the City and County of Denver.

**ARTICLE XVIII – PROMPT PAY:** The Contractor is subject to D.R.M.C. Section 20-112 wherein the Contractor is to pay its subcontractors in a timely fashion. A payment is timely if it is mailed to the subcontractor no later than seven days after receipt of any payment from City. Any late payments are subject to a late payment penalty as provided for in the prompt pay ordinance (Section 20-107 through 20-118).

**ARTICLE XXIV – COLORADO OPEN RECORDS ACT:** The Contractor acknowledges that the City is subject to the provisions of the Colorado Open Records Act, Colorado Revised Statutes §24-72-201 et seq., and the Contractor agrees that it will fully cooperate with the City in the event of a request or lawsuit arising under such act for the disclosure of any materials or information which the Contractor asserts is confidential and exempt from disclosure. Any other provision of this Contract notwithstanding, including exhibits, attachments and other documents incorporated into this Contract by reference, all materials, records and information provided by the Contractor to the City shall be considered confidential by the City only to the extent provided in the Open Records Act, and the Contractor agrees that any disclosure of information by the City consistent with the provisions of the Open Records Act shall result in no liability of the City.

**ARTICLE XV – COMPLIANCE WITH MINORITY/WOMEN BUSINESS ENTERPRISE REQUIREMENTS:** This Contract is subject to all applicable provisions of Divisions 1 and 3 of Article III, of Chapter 28, Denver Revised Municipal Code (D.R.M.C.), designated as Sections 28-31 – 29-36 and 28-52 – 28-90 D.R.M.C. and referred to in this Contract as the “M/WBE Ordinance”. In accordance with the requirements of the M/WBE Ordinance, the Contractor is committed to, at a minimum, meet the participation goal of **Eight Percent (8%)** established for this Project utilizing properly certified M/WBE subcontractors and suppliers. In addition to the applicable provisions of the M/WBE Ordinance, the Contractor agrees, as an express condition of its performance hereunder, to comply with the requirements of any approved Small Business Enterprise Compliance Plan (attached and incorporated herein as **Exhibit A**). Such plan shall, at a minimum, include a narrative regarding compliance with the goal; a list of committed M/WBE participants along with dollar and percent participation for each evidencing compliance with the overall goal, and fully executed letters of intent for each listed participant, all in a form satisfactory to the City. Without limiting the general applicability of the foregoing, the Contractor

acknowledges its continuing duty, pursuant to Sections 28-72, 28-73 and 28-75 D.R.M.C. and the M/WBE Program, to meet and maintain throughout the duration of this Construction Contract its participation and compliance commitments and to ensure that all Subcontractors subject to the M/WBE Ordinance or the M/WBE Program also maintain such commitments and compliance. Failure to comply with these requirements may result, at the discretion of the Director of the Division of Small Business Opportunity (“DSBO”), in the imposition of sanctions against the Contractor in accordance with Section 28-77, D.R.M.C. Nothing contained in this Paragraph or in the referenced City ordinance shall negate the City’s right to prior approval of Subcontractors, or substitutes therefore, under this Construction Contract.

**ARTICLE XVI – ELECTRONIC SIGNATURES AND ELECTRONIC RECORDS:**

Contractor consents to the use of electronic signatures by the City. The Contract, and any other documents requiring a signature hereunder, may be signed electronically by the City in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Contract solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Contract in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

**[END OF PAGE]**

## EXHIBIT B

### PERFORMANCE BOND

**KNOW ALL MEN BY THESE PRESENTS**, that we, the undersigned \_\_\_\_\_  
[Contractor ], a corporation organized under the laws of the State of \_\_\_\_\_ [ Contractor\_state], hereinafter referred to as the "Contractor" and \_\_\_\_\_ [Bond issuer], a corporation organized under the laws of the State of \_\_\_\_\_ [Bond company state], and authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as the "CITY", in the penal sum of \_\_\_\_\_ [Task Order amount text] Dollars (\$\_\_\_\_\_), lawful money of the United States of America, for the payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators, successors and assigns, jointly and severally by these presents.

**WHEREAS**, the above Contractor has, as of the date of execution listed on the contract signature page, entered into a written contract with the City for furnishing all labor, materials, equipment, tools, superintendence, and other facilities and accessories for the construction of 201734681 Passenger Conveyance Modernization On-Call, Denver International Airport, in accordance with the Technical Specifications, Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and made a part hereof, and are herein referred to as the Contract.

**NOW, THEREFORE**, the condition of this performance bond is such that if the Contractor:

1. Promptly and faithfully observes, abides by and performs each and every covenant, condition and part of said Contract, including, but not limited to, its warranty provisions, in the time and manner prescribed in the Contract, and
2. Pays the City all losses, damages (liquidated or actual, including, but not limited to, damages caused by delays in the performance of the Contract), expenses, costs and attorneys' fees, that the City sustains resulting from any breach or default by the Contractor under the Contract, then this bond is void; otherwise, it shall remain in full force and effect.

**IN ADDITION**, if said Contractor fails to duly pay for any labor, materials, team hire, sustenance, provisions, provender, or any other supplies used or consumed by said Contractor or its subcontractors in its performance of the work contracted to be done or fails to pay any person who supplies rental machinery, tools, or equipment, all amounts due as the result of the use of such machinery, tools, or equipment in the prosecution of the work, the Surety shall pay the same in an amount not exceeding the amount of this obligation, together with interest as provided by law.

**PROVIDED FURTHER**, that the said Surety, for value received, hereby stipulates and agrees that any and all changes in the Contract or compliance or noncompliance with the formalities in the Contract for making such changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any such changes.

(End of Page)

**IN WITNESS WHEREOF**, said Contractor and said Surety have executed these presents as of this \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
CONTRACTOR

By: \_\_\_\_\_  
President

\_\_\_\_\_  
SURETY

By: \_\_\_\_\_  
Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

**CITY AND COUNTY OF DENVER**

By: \_\_\_\_\_  
MAYOR

By: \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

**APPROVED AS TO FORM:**

KRISTIN M. BRONSON, Attorney for the  
City and County of Denver

By: \_\_\_\_\_  
Assistant City Attorney

**PAYMENT BOND**

**KNOW ALL MEN BY THESE PRESENTS,** that we, the undersigned \_\_\_\_\_ [Contractor name], a corporation organized under the laws of the State of \_\_\_\_\_ [Contractor state], hereinafter referred to as the "Contractor" and \_\_\_\_\_ [Bonding company name], a corporation organized under the laws of the State of \_\_\_\_\_ [Bonding company state], and authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as the "CITY", in the penal sum of \_\_\_\_\_ [Proposal amount text] Dollars (\$ \_\_\_\_\_), lawful money of the United States of America, for the payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the above Contractor has entered into a written contract with the City for furnishing all labor, materials, tools, superintendence, and other facilities and accessories for the construction of Contract No. \_\_\_\_\_ Denver International Airport, in accordance with the Technical Specifications, Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and made a part hereof, and are herein referred to as the Contract.

**NOW, THEREFORE,** the condition of this payment bond obligation is such that if the Contractor shall at all times promptly make payments of all amounts lawfully due to all persons supplying or furnishing it or its subcontractors with labor and materials, rental machinery, tools, or equipment, used or performed in the prosecution of work provided for in the above Contract and shall indemnify and save harmless the City to the extent of any and all payments in connection with the carrying out of such Contract which the City may be required to make under the law, then this obligation shall be null and void, otherwise, it shall remain in full force and effect;

**PROVIDED FURTHER,** that the said Surety, for value received, hereby stipulates and agrees that any and all changes in the Contract, or compliance or noncompliance with the formalities in the Contract for making such changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any such changes.

[END OF PAGE]

**IN WITNESS WHEREOF**, said Contractor and said Surety have executed these presents as of this \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
CONTRACTOR

By: \_\_\_\_\_  
President

\_\_\_\_\_  
SURETY

By: \_\_\_\_\_  
Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

CITY AND COUNTY OF DENVER

By: \_\_\_\_\_  
MAYOR

By: \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

APPROVED AS TO FORM:

KRISTIN M. BRONSON, Attorney for the  
City and County of Denver

By: \_\_\_\_\_  
Assistant City Attorney



**EXHIBIT C**  
**CITY AND COUNTY OF DENVER**  
**DEPARTMENT OF AVIATION**

\*\*\*\*\*

**NOTICE TO PROCEED**

Date:

TO: [Contractor name and address]

You are hereby authorized and directed to proceed on this date with the work of constructing Contract No. 201734681, Passenger Conveyance Modernization On-Call, Denver International Airport, Denver, Colorado, as set forth in detail in the Contract Documents for the City and County of Denver.

CITY AND COUNTY OF DENVER

By \_\_\_\_\_  
Senior Vice President  
Airport Infrastructure Management

By \_\_\_\_\_  
Chief Executive Officer  
Denver International Airport

**City and County of Denver**



**DENVER**  
THE MILE HIGH CITY

DEPARTMENT OF AVIATION  
DEPARTMENT OF PUBLIC WORKS

**STANDARD SPECIFICATIONS FOR  
CONSTRUCTION  
GENERAL CONTRACT CONDITIONS**

2011 Edition

**Statement**

The City and County of Denver does not warrant or represent the accuracy or timeliness of the information contained in this page or any of its constituent pages and the information presented is for instructional purposes and illustration only and is not intended to be specific advice, legal or otherwise. The City has made every effort to provide accurate up-to-date information, however this database is dynamic and errors can occur. The City and County of Denver shall not be held responsible for errors or omissions nor be liable for any special consequential or exemplary damages resulting, in whole or in part, from any viewer(s)' uses of, or in reliance upon, this material.

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## EXHIBIT F

### SPECIAL CONDITIONS

#### SC-1 CONSTRUCTION CONTRACT GENERAL CONDITIONS

The Construction Contract General Conditions which constitute a part of the Contract Documents are set forth in a separately published document, entitled "City and County of Denver, Department of Aviation and Department of Public Works, Standard Specifications for Construction, General Contract Conditions," 2011 Edition, the Table of Contents to which is bound herein (which may be informally referred to as the Yellow Book). The General Conditions book is available for purchase for \$12.00 per copy at the following locations during the business hours stated, Monday through Friday, excluding holidays:

Office of the Cashier  
Wellington E. Webb Municipal Office Building, 2nd Floor  
201 West Colfax Avenue  
Denver, Colorado, USA 80202  
7:30 a.m. to 4:30 p.m.

The General Conditions are also available on the DEN Contract Procurement on the City and County of Denver website at:

<https://www.denvergov.org/content/dam/denvergov/Portals/743/documents/2011%20DENVER%20GENERAL%20CONTRACT%20CONDITIONS.pdf>

#### SC-2 DRAWINGS AND SPECIFICATIONS TO BE FURNISHED BY THE CITY

The City will provide the following Contract Documents to the Contractor in electronic format at no expense to the Contractor:

Document

Volumes 1 & 2 (See the Master Table of Contents, page TOC-3, for the content of these volumes)  
Contract Drawings

Additional copies of the foregoing documents will be furnished to the Contractor at the Contractor's expense. The Contractor will be responsible for supplying all subcontractors with copies of the Contract Documents at its expense.

If Sensitive Security Information ("SSI") is provided to the Contractor, the Contractor shall be required to comply with Department of Aviation, Standard Policies and Procedures No. 6003, "Contractor Protection of Sensitive Security Information," or its successor, and 49 C.F.R. § 1520, or its successor.

The City will not supply any copies of the General Contract Conditions to the Contractor at City expense.

#### SC-3 REVISIONS TO G.C. 201

The second sentence of General Condition 201 is amended to read: "The unit responsible for this

management and control is the Airport Infrastructure Management Office under the supervision of the Senior Vice President for Maintenance and Airport Infrastructure Management.”

#### **SC-4 CITY LINE OF AUTHORITY AND CONTACTS**

In accordance with General Condition 214, the City’s line of authority for administration of this Contract is:

Chief Executive Officer (CEO). Executive Office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249. Any reference to the Manager of Aviation shall also mean Chief Executive Officer, Department of Aviation (CEO).

Executive Vice President – Chief Operating Officer (EVP-COO) who reports to the CEO. Airport Infrastructure Management office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Senior Vice President - Airport Infrastructure Management (SVP-AIM) who reports to the COO. Airport Infrastructure Management office, 10th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Director of Infrastructure and Quality Assurance, reports to the SVP-AIM. The Project Manager reports to the Director of Infrastructure and Quality Assurance. Airport Infrastructure Management Division, 7<sup>th</sup> Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Project Manager, the City representative who has day to day administrative responsibility of this Contract, and who reports to the SVP-AIM. All notices, requests, pay applications (pursuant to G.C. 902), and other correspondence from the Contractor shall be sent to the assigned Project Manager unless otherwise provided in this Contract. The Project Manager for this Contract is: Joshua Spoon, Airport Infrastructure Management Office, 7th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249, phone 303-342-2200.

The CEO may from time to time substitute a different City official as the designated “SVP-AIM” hereunder, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor SVP-AIM. The SVP-AIM may from time to time change the assigned Project Manager, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor Project Manager.

#### **SC-5 CONTRACTOR PERFORMANCE; SUBCONTRACTING**

With respect to General Condition 501, no more than ninety-five percent (95%) of the work may be subcontracted. If it is determined to be in the City’s best interest, this percentage may be modified throughout the course of the project by the SVP-AIM.

#### **SC-6 COOPERATION WITH OTHERS**

The Technical Specifications describe the constraints on the physical work site areas. These descriptions are not exhaustive and the Contractor is required to coordinate its activities and work as may be required to meet FAA or City requirements while performing work on DEN.



Without limiting the foregoing, the following contracts administered by the City involve or may involve work overlapping or adjoining the Work under this Contract, and may be prosecuted concurrently with the Work performed under this Contract. There may also be other adjoining or overlapping contracts which are not listed.

**SC-7 PROSECUTION AND COMPLETION OF THE WORK:**

The Work to be performed under the Contract is described in the Technical Specifications and Contract Drawings. The Contractor shall complete the Work within 1825 consecutive calendar days from Notice to Proceed.

The Work to be performed under the Contract may be divided into the Milestone Areas which are described in the Technical Specifications or Contract Drawings. The Contractor shall complete the work included within these areas within the number of days set forth by the Project Manager.

**SC-8 LIQUIDATED DAMAGES**

If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, the Contractor shall be liable to the City for liquidated damages at the rate of Two Thousand Dollars (\$2,000.00) per day until substantial completion is achieved.

Article IV of the Contract and General Condition 602 cover payment and withholding of liquidated damages.

**SC-9 FACILITY SECURITY AND PERSONNEL ACCESS**

The Contractor shall conduct all its activities at the Airport in compliance with the Airport security system rules and regulations, which are administered by the Airport Operations Division. The Contractor shall obtain the proper access authorizations for its employees, subcontractors and suppliers (i.e., Badges and Permits), and shall be responsible for such persons' compliance with all the Airport rules and regulations. A copy of the Contractors' section of the Airport Security rules and regulations are available for Contractor review at the Airport Access Services Office, Concourse A East Subcore, 4th Level. Persons regularly entering the construction areas must obtain personnel access badges from the Airport Access Services Office and must display badges, at all times, upon entering the construction, restricted and sterile areas of the airport.. Any employee, subcontractor or supplier who violates such rules may be subject to revocation of his access authorization, including authorization for access to the construction site and all other restricted and sterile areas.

The security status of the Airport is subject to change without notice. These contract Special Conditions are applicable to the current security status of the Airport. Should the security status of the Airport change at any time during the term of this Contract, a written notice shall be issued to the Contractor detailing all applicable security modifications from the airport's current security status. The Contractor shall take **immediate steps** to comply with those security modifications as directed in the written notice.

If these security modifications involve any additional project cost, the Contractor shall submit a Contractor Change Request in accordance with the General Conditions for the additional cost. The Contractor Change Request shall outline in specific detail the effects of the security modifications on the

Contractor's performance of the Contract, and shall provide a detailed cost breakdown for each item for which the Contractor is requesting reimbursement.

The Contractor shall return to the City, at contract completion or termination, or upon demand by the City, all access keys issued to it by the City to all areas of the Airport. If the Contractor fails to return any such key or keys at contract completion or termination or upon demand by the City, the Contractor shall be liable to the City for all the City's costs, including the City's labor costs for employees, incurred in re-coring doors and any other work which is required to prevent compromise of the Airport security system. In order to collect such costs hereunder, the City may withhold funds in such amount from any amounts due and payable to the Contractor under this Contract.

The construction of all the Project / Task Items that involve the breaching of any airport perimeter security boundary or continued access to restricted access rooms or areas will require the posting of authorized contract security personnel to maintain required security controls. The Contractor's **Guarantee Maximum Price / Total Contract BID Amount / Task Order Proposal** shall include the cost of providing security services to maintain control and supervision of any and all airport perimeter security boundary breaches and for the duration of work activities where access to restricted areas is required and until the airport perimeter security boundaries are reestablished.

When security boundaries are opened for any reason, the Contractor must maintain one hundred percent (100%) control and supervision for the entire time that the openings are present to prevent unauthorized access to the secure / restricted access areas.

**THE IMPORTANCE OF THIS SPECIAL CONDITION CANNOT BE OVER-EMPHASIZED. SEVERE FINANCIAL PENALTIES AS WELL AS CONTRACT TERMINATION COULD RESULT IF AIRPORT PERIMETER SECURITY REQUIREMENTS ARE NOT STRICTLY FOLLOWED. THE REQUIREMENT TO PROVIDE ONE HUNDRED PERCENT (100%) CONTROL AND SUPERVISION OF BREACHES IN THE AIRPORT'S PERIMETER SECURITY BOUNDARY IS ABSOLUTE. AT NO TIME, DURING WORK AND NON-WORK HOURS SHALL ANY BREACHES IN THE AIRPORT'S SECURITY PERIMETER BE UNSUPERVISED AND / OR UNSECURED.**

For off-hours of construction, the Contractor may choose to erect a temporary wall to close all perimeter openings. The wall construction shall be of sufficient materials and strength to prevent access to the airport's Sterile/Restricted Areas. The Contractor shall submit for review and approval, the details and materials for the temporary closure of security perimeter breaches for review and approval.

The Contractor will provide contract security guard services to maintain supervision of these openings. The security services must provide coverage to allow for lunch breaks, comfort breaks and etc. The security services **must** be obtained from the following contract security guard company:

HSS  
900 S. Broadway, Suite 100  
Denver, Colorado 80209

DEN Contact: Glenn Spies  
(303) 342-4323

All security guards provided for this project must have a Denver Airport SIDA Badge.

The DEN Security Guard Contractor may change between the bidding or proposal phase of this contract from Notice to Proceed to closure of all security perimeter breaches. The Contractor shall maintain a contractual relationship with the Security Guard Contractor holding the most current contract with Denver International Airport.

The Contractor shall continue to provide security of these areas until such time that the breaches in the airport's security perimeter have been permanently secured.

The Contractor shall submit a written security plan for approval to the Director of Airport Security prior to the start of construction on any work where a breach of the perimeter security boundaries is required.

### **SC-10 CONSTRUCTION ACCESS**

The work site is located at 26920 E. 86<sup>th</sup> Avenue, Denver, CO 80249. The Contractor shall have access to the work site via Airport Office Building (AOB) Gate, with all equipment and materials delivery routes TBD.

The City will not provide parking spaces for the Contractor's employees or subcontractor employees at the Airport. Arrangements for transportation and parking for all of its and its subcontractors employees will be the responsibility of the Contractor. The Total Contract Bid Amount or Contract Amount shall include any and all costs associated with the Contractor's and subcontractors' employee parking. Information about parking facilities and charges is available from the Airport Parking Office. Refundable deposits are required for all parking passes.

Unless specifically required by the Contract Documents, the Contractor shall install no fences or other physical obstructions on or around any project work area without the approval of the City.

### **SC-11 VEHICLE PERMITTING**

Vehicle access on the Airport Operation Area ("AOA") is controlled by and requires permission from the Airport Access Services Office. It is not anticipated that the Contractor will need to operate vehicles on the AOA to perform the Work. Only direct construction support vehicles and/or equipment will be allowed in the contractor's work areas or sites.

### **SC-12 VENDORS AND SUPPLIERS**

The Contractor shall provide the Project Manager's office with a list of its equipment/material vendors and suppliers. Vendors or suppliers shall access the construction work areas via the Contractor's access route, described in SC-10 above. All delivery vehicles are subject to search.

### **SC-13 COMMUNICATION DEVICES**

Any site communications devices, mobile communication devices or internet data devices used at DEN must be approved by DEN Technologies.

#### **SC-14 USE, POSSESSION OR SALE OF ALCOHOL OR DRUGS**

The Contractor and its officers, agents, and employees shall cooperate and comply with the provisions of Executive Order No. 94 and Attachment A thereto concerning the use, possession, or sale of alcohol or drugs. Violation of these provisions or refusal to cooperate with implementation of the policy can result in the City's barring the Contractor from City facilities or participating in City operations.

#### **SC-15 ATTORNEY'S FEES**

Colorado Revised Statute 38-26-107 requires that in the event any person or company files a verified statement of amounts due and unpaid in connection with a claim for labor and materials supplied on this project, the City shall withhold from payments to the Contractor sufficient funds to insure the payment of any such claims. Should the City and County of Denver be made a party to any lawsuit to enforce such unpaid claims or any lawsuit arising out of or relating to such withheld funds, Contractor agrees to pay to the City its costs and a reasonable attorney's fee. Because the City Attorney Staff does not bill the City for legal services on an hourly basis, Contractor agrees a reasonable fee shall be computed at the rate of one hundred dollars per hour of City Attorney time.

#### **SC-16 INSURANCE REQUIREMENTS**

In accordance with the provisions of Title 16 of the General Conditions, the minimum insurance requirements for this contract are set forth in the Exhibit H, attached to this Contract. The Contractor specifically agrees to comply with each condition, requirement or specification set forth in the attachment for each required coverage during all periods when the required coverage's are in effect.

Contractor and sub-contractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this Contract are satisfied, required insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or sub-contractors.

The insurance requirements herein are minimum requirements for this Contract and in no way limit the indemnity covenants contained in this Contract.

The City and County of Denver in no way warrants that the minimum limits contained herein are sufficient to protect the Contractor from liabilities that might arise out of the performance of the work under this Contract by the Contractor, his agents, representatives, employees or sub-contractors. The Contractor shall assess its own risks as it deems appropriate and/or prudent, maintain higher limits and/or broader coverages. The Contractor is not relieved of any liability or other obligations assumed or pursuant to the Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration or types.

Contractor shall furnish the City and County of Denver with certificates of insurance (ACORD form or equivalent approved by CCD) as required by this Contract. The certificates for each insurance policy are to be signed by a person authorized by the insurer to bind coverage on its behalf.

All certificates and any required endorsements are to be received and approved by the City before work

commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract or to provide evidence of renewal is a material breach of the Contract. All insurance coverages for sub-contractors shall be subject to the minimum requirements identified in the Exhibit. All sub-contractors certificates and endorsements shall be received and approved by the Contractor before work commences. The City reserves the right to request copies of these certificates at any time.

All certificates required by this Contract shall be sent directly to Denver International Airport, Business Management Services, Airport Office Building, Room 8810, 8500 Pena Boulevard, Denver, Colorado 80249. The City project/Contract number and project description shall be noted on the certificate of insurance. The City reserves the right to require complete, certified copies of all insurance policies required by this Contract at any time.

The parties hereto understand and agree that the City and County of Denver, its officers, officials and employees, are relying on, and do not waive or intend to waive by any provisions of this Contract, the monetary limitations or any other rights, immunities and protections provided by the Colorado Governmental Immunity Act, §§ 24-10-101 - 120, C.R.S., or otherwise available to the City and County of Denver, its officers, officials and employees.

#### **SC-17 SUBCONTRACTOR RELEASES**

The release form referred to in General Condition 907 is attached to this Contract. It is entitled "Denver International Airport Partial Release."

#### **SC-18 ADDITIONAL AFFIRMATIVE ACTION REQUIREMENTS, FEDERAL PROVISIONS**

This contract is subject and subordinate to the terms, reservations, restrictions, and conditions of any existing or future agreements between the City and the United States, the execution of which has been or may be required as a condition precedent to the transfer of federal rights or property to the City for airport purposes, and the expenditure of federal funds for airport purposes. The "Federal Requirements" section attached hereto is made a part of this Contract.

#### **SC-19 ESTIMATED QUANTITIES OF UNIT PRICED ITEMS**

The "total estimated quantity" of each unit price item as stated on the bid schedules shall be the estimated quantity which is used to determine the percentage of change in such item for purposes of G.C. 1104.7.

#### **SC-20 REVISIONS TO G.C. 1102**

G.C. 1102.2 is amended by replacing the phrase "Change Request" in all its occurrences in such G.C. with the phrase "Change Notice."

G.C. 1102.3 is amended by replacing the phrase "Field Order/Change Order Directive" in all its occurrences in such G.C. with the phrase "Change Order Directive."

## **SC-21 LISTING OF ACCEPTABLE MANUFACTURERS**

The Technical Specifications list “Acceptable Manufacturers” for certain products. Such listing identifies manufacturers of certain products which have been determined by a preliminary review to be able to meet the basic product and/or system technical requirements. The listing is not intended to provide a blanket endorsement or acceptance of the manufacturer’s specified products or product line. All products from listed manufacturers must meet the detailed requirements of the Technical Specifications. Products that do not meet all detailed Technical Specifications are not acceptable and will be rejected, regardless of whether the manufacturer was listed as “acceptable.” The Contractor is responsible for determining the acceptability of all products under the Technical Specifications prior to submission of products for approval.

## **SC-22 ACCESSIBLE PARKING SPACES, ACCESS AISLES AND ROUTES OF TRAVEL**

If any Work is performed in or adjacent to parking facilities at the Airport, the Contractor is responsible for compliance with this SC-30. “Accessible” parking spaces and access aisles as used in this SC-30 mean parking spaces and access aisles which are accessible for, and reserved for use by, persons with disabilities. These parking spaces and access aisles are designed and built to standards established by federal regulations implementing the Americans with Disabilities Act of 1990 (“ADA”), and are marked by signage. “Accessible routes of travel” as used herein means routes through parking facilities which comply with ADA accessibility standards, including degree of slope and absence of obstructions.

Accessible routes of travel and accessible parking spaces and access aisles must be kept free of obstructions and construction debris at all times. No accessible parking spaces or access aisles or accessible routes of travel shall be relocated, blocked or rendered unusable unless the contractor has obtained specific advance approval in writing for such actions from the airport’s ADA Compliance Officer.

When prosecution of the Work requires that accessible spaces be temporarily blocked, those accessible spaces and their access aisles shall be temporarily relocated to another location as close as possible to an accessible building entrance. Temporary signage that identifies these parking spaces and access aisles as reserved for the handicapped shall be installed, and the accessible route shall be clearly marked as required.

Before blocking or relocating accessible parking spaces or accessible routes of travel, the contractor must obtain written approval from the DEN ADA Compliance Officer, by submitting a completed request form, which will be provided to the Contractor by the Project Manager at the preconstruction meeting if it is not included as a standard form in Section 019990 of the Technical Specifications. The request shall include the location of alternative spaces and/or routes, and specifications of the temporary signage to be used. Work shall not proceed without this approval.

If a vehicle is parked in any accessible space which is either temporary or approved to be relocated, the contractor will not remove signage or take any other action which would allow the access aisle for such parking space to be blocked. Such actions must be postponed until the parking space is no longer occupied.

## **SC-23 SUBCONTRACTOR PAYMENTS AND SUBCONTRACTOR RELEASES – REQUIRED USE OF THE B2G CONTRACT MANAGEMENT SYSTEM**

The Contractor is required to use the City B2G Contract Management System to report all subcontractor payments and shall adhere to the City's Procedure for Reporting Subcontractor Payments. It is the Contractor's obligation to ensure that complete subcontractor information is entered into the B2G System prior to submission of the first application for payment in order to avoid any delays in payment. The Contractor shall, prior to the submission of each subsequent invoice, ensure payments to subcontractors have been entered into the B2G System, including subcontractor confirmation of amount of payment received, for services performed during the prior billing period.

### **SC-24 PAYMENTS TO CONTRACTORS**

The Contractor recognizes and agrees that applications for payment shall be submitted using the Textura® Construction Payment Management System (CPM System), which will also be the payment mechanism to disburse payments to sub-contractors used on this Project. For more information, please refer to Division I, Technical Specifications.

The Contractor further agrees that, to the fullest possible within the CPM System, the City shall be entitled to all non-Confidential records, reports, data and other information related to the project that are available to Contractor through the CPM System, including, but not limited to, information related to Contractor and subcontractor billings. To that end, Contractor agrees that it will activate any available settings within the CPM System that are necessary to grant the City access to such non-Confidential information related to the contract and the project. Applications for payment shall be based on the Contract Unit Prices or the approved Schedule of Values described in GC 903.1

In accordance with General Contract Condition 902, PAYMENT PROCEDURE, The party(ies) responsible for review of all Pay Applications shall be:

**Agency/Firm**  
DEN Division CA  
DEN Division PM  
DEN Division Director  
DEN Contract Svcs CA  
CCD Denver Prevailing Wage

In accordance with General Contract Condition 906, APPLICATIONS FOR PAYMENT, each Application submitted shall include the following:

1. The estimate of Work completed shall be based on the approved schedule of values or unit prices, as applicable, and the percent of the Work complete.
2. Each Application for Payment shall include each and every independent subcontractor's payroll information including pay dates and pay amounts.
3. The Contractor shall also submit to the Auditor and other appropriate officials of the City in a timely fashion, information required by General Contract Condition 1004, REPORTING WAGES PAID.

In accordance with General Contract condition 907, RELEASES AND CONTRACTORS CERTIFICATION OF PAYMENT, applications for Payment must be accompanied by completed Partial or Final Claim Release Form, as appropriate, from EACH subcontractor and supplier, **AND** the Contractor's Certification of Payment Form.

# **INSURANCE CERTIFICATE OR REQUIREMENTS**

**The insurance requirements which apply to this contract are  
contained in the pages immediately following this page  
which include the following attachments:**

**These pages are not included in the page numbering of this contract document.**





## II. ADDITIONAL COVERAGE

### Excess/Umbrella Liability

#### Minimum Limits of Liability (In Thousands):

|                                        |                               |         |
|----------------------------------------|-------------------------------|---------|
| Umbrella Liability Controlled Area     | Each Occurrence and aggregate | \$9,000 |
| Umbrella Liability Non-Controlled Area | Each Occurrence and aggregate | \$1,000 |

The policy must provide the following:

1. Coverage must be written on a "follow form" or broader basis.
2. Any combination of primary and excess coverage may be used to achieve required limits.
3. If operations include unescorted airside access at DIA, then a \$9 million Umbrella Limit is required.

### Builders' Risk Insurance or Installation Floater

#### Minimum Limits of Liability (In Thousands)

Special Completed Value Basis

The policy must provide the following:

1. The insurance must be in the amount of the initial Contract Sum, plus value of subsequent modifications, change orders, and cost of material supplied or installed by others, comprising total value of the entire Project at the site on a replacement cost basis.
2. The insurance shall be written on a **Special Completed Value** Covered Cause of Loss form and shall include theft, vandalism, malicious mischief, collapse, false-work, temporary buildings, transit, debris removal, demolition, increased cost of construction, flood (including water damage), earthquake, and if applicable, all below and above ground structures, piping, foundations including underground water and sewer mains, pilings including the ground on which the structure rests and excavation, backfilling, filling and grading.
3. The Policy shall remain in force until formal acceptance of the project by the City or the placement of permanent property insurance coverage whichever is later.
4. The Builders' Risk shall include a Beneficial Occupancy Clause. The policy shall specifically permit occupancy of the building during construction. Contractor shall take reasonable steps to obtain consent of the insurance company and delete any provisions with regard to restrictions within any Occupancy Clauses within the Builder's Risk Policy.
5. Equipment Breakdown Coverage (a.k.a. Boiler & Machinery) shall be included as required by the Contract Documents or by law, which shall specifically covers insured equipment during installation and testing (including cold and hot testing).

## III. ADDITIONAL CONDITIONS

It is understood and agreed, for the benefit of the City, that the following additional conditions shall apply to all coverage specified herein:

1. For Commercial General Liability, Auto Liability and Excess Liability/Umbrella (if required), Contractor and subcontractor's insurer(s) shall include the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured.
2. All coverage provided herein shall be primary and any insurance maintained by the City shall be considered excess.
3. For all coverages required under this Agreement, Contractor's insurer shall waive subrogation rights against the City.
4. The City shall have the right to verify or confirm, at any time, all coverage, information or representations contained herein, and the insured and its undersigned agent shall promptly and fully cooperate in any such audit the City may elect to undertake.
5. The required insurance shall be underwritten by an insurer licensed or authorized to do business in Colorado and rated by A.M. Best Company as "A-"VIII or better.
6. For claims-made coverage, the retroactive date must be on or before the contract date or the first date when any goods or services were provided to the City, whichever is earlier
7. No changes, modifications or interlineations on this document shall be allowed without the review and approval of the Risk Administrator prior to contract execution.

### **NOTICE OF CANCELLATION**

It is understood and agreed that should any Policy issued hereunder be cancelled or non-renewed before the expiration date thereof, or sustain a material change in coverage adverse to the City, the issuing company or its authorized Agent shall give notice to the Department of Aviation in accordance with policy provisions.



## DENVER INTERNATIONAL AIRPORT PARTIAL LIEN RELEASE – CONSTRUCTION (Subcontractor)

|                              |                                                                          |
|------------------------------|--------------------------------------------------------------------------|
| Project: _____               | Date: _____                                                              |
| City Contract No. _____      | Current Subcontract Amount: \$ _____                                     |
| FROM:<br>Subcontractor _____ | (1) Last Progress Payment for billing period ending _____ 20__           |
| Address: _____               | \$ _____                                                                 |
| City/State: _____            | (2) Progress invoiced for previous billing period (if unpaid) _____ 20__ |
| Telephone: _____             | \$ _____                                                                 |
| TO:<br>Contractor _____      | (3) Progress invoiced for current billing period ending _____ 20__       |
| Address: _____               | \$ _____                                                                 |
| City/State: _____            | (4) <b>Total Paid to Date:</b>                                           |
|                              | \$ _____                                                                 |

( ) MBE/WBE      ( ) SBE      ( ) DBE      ( ) Non

The Undersigned hereby certifies that all costs, charges or expenses incurred by the undersigned or on behalf of the undersigned for any work, labor or services performed and for any materials, supplies or equipment provided on the above referenced Project or used in connection with the above referenced Subcontract (the "Work Effort") have been duly paid in full to date.

The Undersigned further certifies that each of the undersigned's subcontractors and suppliers that incurred or caused to be incurred, on their behalf, costs, charges or expenses in connection with the undersigned's Work Effort on the above referenced Project have been duly paid in full to date.

The Undersigned hereby (1) acknowledges receipt of the progress payment referred to above as the Last Progress Payment which, when added to the total of all previous progress payments, constitutes full payment, less retainage, for all labor, services, material and supplies which the undersigned has provided for use in and upon the project described above through \_\_\_\_\_, 20\_\_ and, (2) hereby releases the Contractor, surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier from any and all claims prior to the above mentioned date, except for the withheld retainage.

The Undersigned also hereby agrees that the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier shall be released from any and all claims arising out of its performance or non-performance of any contract associated with the above project through \_\_\_\_\_, 20\_\_, except for withheld retainage after it has received full payment, less retainage, of the amount invoiced for the current billing period.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and hold harmless the City, its officers, employees, agents and assigns and the above-referenced Contractor from and

against all costs, losses, damages, causes of action, judgments under the subcontract and expenses arising out of or in connection with any claim or claims against the City or the Contractor which arise out of the Undersigned's performance of the Work Effort and which may be asserted by the Undersigned or any of its suppliers or subcontractors of any tier or any of their representatives, officers, agents, or employees.

It is acknowledged that this release is for the benefit of and may be relied upon by the City and the referenced Contractor.

The foregoing shall not relieve the undersigned of any obligation under the provisions of the Undersigned's subcontract, as the subcontract may have been amended, which by their nature survive completion of the Undersigned's work effort including, without limitation, warranties, guarantees, insurance requirements and indemnities.

Subcontractor: \_\_\_\_\_

Certified by: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_



# DENVER INTERNATIONAL AIRPORT FINAL LIEN RELEASE – CONSTRUCTION (Subcontractor)

Project: \_\_\_\_\_ Date: \_\_\_\_\_

City Contract No. \_\_\_\_\_ Subcontractor Contract No. \_\_\_\_\_

FROM: Dated: \_\_\_\_\_, 20\_\_

Subcontractor: \_\_\_\_\_ (1) Last Progress Payment for billing  
period ending \_\_\_\_\_, 20\_\_

Address: \_\_\_\_\_ \$ \_\_\_\_\_

City/State: \_\_\_\_\_ (2) Does not apply

Telephone: \_\_\_\_\_

TO: Contractor: \_\_\_\_\_ (3) Does not apply

Address: \_\_\_\_\_

City/State: \_\_\_\_\_ (4) **Total Paid to Date:**  
\$ \_\_\_\_\_

SBE       DBE       MBE       WBE       Non

The Undersigned hereby certifies that all costs, charges or expenses incurred by the undersigned or on behalf of the undersigned for any work, labor or services performed and for any materials, supplies or equipment provided on the above referenced Project or used in connection with the above referenced Subcontract (the "Work Effort") have been duly paid in full.

The Undersigned further certifies that each of the undersigned's subcontractors and suppliers that incurred or caused to be incurred, on their behalf, costs, charges or expenses in connection with the undersigned's Work Effort on the above referenced Project have been duly paid in full.

The undersigned Subcontractor hereby (1) acknowledges receipt of the progress payment referred to above as the Last Progress Payment which, when added to the total of all previous progress payments, constitutes full payment for all labor, services, materials and supplies which the undersigned has provided for use in and upon the project described above through \_\_\_\_\_, 20\_\_ and, (2) hereby releases the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier from any and all claims prior to the above mentioned date.

The Subcontractor also hereby agrees that the Contractor, Surety, the City and County of Denver, and any intermediate subcontractor or supplier of any tier shall be released from any and all claims arising out of its performance or non-performance of any contract associated with the above project.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and hold harmless the City, its officers, employees, agents and assigns and the above-referenced Contractor from and against all costs, losses, damages, causes of action, judgments under the subcontract and expenses arising out of or in connection with any claim or claims against the City or the Contractor which arise out of the Undersigned's performance of the Work Effort and which may be asserted by the Undersigned or any of its suppliers or subcontractors of any tier or any of their representatives, officers, agents, or employees.

It is acknowledged that this release is for the benefit of and may be relied upon by the City and the referenced Contractor.

The foregoing shall not relieve the undersigned of any obligation under the provisions of the Undersigned's subcontract, as the subcontract may have been amended, which by their nature survive completion of the Undersigned's work effort including, without limitation, warranties, guarantees, insurance requirements and indemnities.

Subcontractor: \_\_\_\_\_

Certified by: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

**EXHIBIT I**

**CITY AND COUNTY OF DENVER  
RULES AND REGULATIONS AND TASK ORDER  
CONDITIONS OF THE  
MANAGER OF PUBLIC WORKS**

**PERTAINING TO EQUAL EMPLOYMENT OPPORTUNITY  
IN THE CITY AND COUNTY OF DENVER**

APPROVED FOR LEGALITY:

APPROVED AND ADOPTED:

/s/ \_\_\_\_\_  
Attorney for the City and  
County of Denver

/s/ \_\_\_\_\_  
Manager of Public Works

Adopted and Published Pursuant to Article 111, Division 2 of Chapter 28  
the Revised Municipal Code  
of the City and County of Denver

These Rules and Regulations cancel and supersede any and all previous issued Rules and  
Regulations on the subject

**RULES AND REGULATIONS**  
**REGARDING**  
**EQUAL EMPLOYMENT OPPORTUNITY**

Promulgated and adopted by the Manager of Public Works pursuant to and by authority of Article III, Division 2, Chapter 28 of the Revised Municipal Code of the City and County of Denver, and for the purpose of insuring that contractors, subcontractors and suppliers soliciting and receiving compensation for contract work from or through the City and County of Denver provide equal opportunity in employment without regard to race, color, creed, sex, national origin, age, religion, marital status, political opinion or affiliation or mental or physical handicap and meet certain requirements for the hiring, training, promotion and treatment during employment of members of ethnic groups subjected to differential treatment, including persons of African descent (Black), Spanish-surnamed (Hispanic), Asian-American and American Indian groups.

**RULE I**  
**DEFINITIONS**

- A. "City" means the City and County of Denver.
- B. "Manager" shall mean the Manager of Public Works for the City and County of Denver.
- C. "Contract" means a contract entered into with the City and County of Denver, financed in whole or in part by local resources or funds of the City and County of Denver, for the construction of any public building or prosecution or completion of any public work.
- D. "Contractor" means the original party to a contract with the City and County of Denver, also referred to as the "general" or "prime" contractor.
- E. "Director" means the Director of the Mayor's Office of Contract Compliance.
- F. "Subcontractor" means any person, company, association, partnership, corporation, or other entity which assumes by subordinate agreement some or all of the obligations of the general or prime contractor.
- G. The Phrase "Bidding Specifications" as used in Article 111, Division 2 of Chapter 28 of the Revised Municipal Code shall include BID CONDITION, INVITATION TO BID AND NOTICE OF PROPOSAL.
- H. "Affirmative Action Program" means a set of specific and result-oriented procedures or steps to which a contractor commits himself to apply every good faith effort to employ members of ethnic minority groups, to include persons of African descent (Black), Spanish surnamed (Hispanic), Asian-American, American Indians, and persons with mental or physical handicap.
- I. "Mayor's Office of Contract Compliance" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

**RULE 11**  
**NOTICE OF HEARING**

When results of conciliation efforts are unsatisfactory to the Manager and he is informed in accordance with Article III, Division 2 of Chapter 28 of the Revised Municipal Code that a contractor or subcontractor has apparently failed to meet affirmative action and equal



employment opportunity requirements after a reasonable period of notice to correct deficiencies, the Manager will, prior to imposition of any sanctions, afford the general contractor a hearing in order to determine whether the contractor or his subcontractors have failed to comply with the affirmative action and equal employment opportunity requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or of the contract. Written notice of such hearing shall be delivered personally or sent by certified mail return receipt requested, to the contractor and to any subcontractor involved at least ten days prior to the date scheduled for the hearing.

### **RULE III** **HEARING**

- A. Contractors will appear at hearings and may be represented by counsel, and may present testimony orally and other evidence.
- B. Hearings shall be conducted by one or more hearing examiners designated as such by the Manager.
- C. The Director of the Mayor's Office of Contract Compliance may participate in hearings as a witness.
- D. Hearings shall be held at the place specified in the notice of hearing.
- E. All oral testimony shall be given under oath or affirmation and a record of such proceedings shall be made.
- F. All hearings shall be open to the public.
- G. The hearing officer shall make recommendations to the Manager who shall make a final decision.

### **REGULATIONS**

**REGULATION NO. 1.**      **ORDINANCE:** The Rules and Regulations of the Manager shall be inserted in the bidding specifications for every contract for which bidding is required.

**REGULATION NO. 2.**      **EXEMPTIONS:** Each contract and subcontract, regardless of dollar amount, shall be subject to affirmative action requirements unless specifically exempted in writing individually by the Manager. Exemptions apply only to "affirmative action" in equal employment opportunity, and are not to be construed as condonation in any manner of "discrimination" or "discriminatory practices" in employment because of race, color, creed sex age national origin, religion, marital status, political opinion or mental or physical handicap.

**REGULATION NO. 3.**      **DIRECTOR OF CONTRACT COMPLIANCE:** The Director of the Mayor's Office of Contract Compliance shall perform the duties assigned to such official by Article III, Division 2 of Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Mayor's Office of Contract Compliance or designated representatives shall inform bidders and contractors of affirmative action procedures, programs, and goals in accordance with the ordinance at pre-bid and pre-construction conference; (2) make regular on-site inspections; (3) supply contractors and subcontractors with report forms to be completed by them when requested, and furnished to the Director of the Mayor's Office of Contract Compliance; and (4) review payroll records, employment records and practices of general contractors and their subcontractors and suppliers during the performance of any contract. The Director of the Mayor's Office of Contract Compliance shall promptly report apparent affirmative action deficiencies to the Manager.

**REGULATION NO. 4. GOALS AND TIMETABLES:** In general, goals and timetables should take into account anticipated vacancies and the availability of skills in the market place from which employees should be drawn. In addition, where discrimination in employment by a general contractor or any of his subcontractors is indicated, a corrective action program will take into account the need by the general contractor and his subcontractors to correct past discriminatory practices and reach goals of minority manpower utilization on a timely basis through such recruiting and advertising efforts as are necessary and appropriate.

**REGULATION NO.5. AWARD OF CONTRACTS:** It shall be the responsibility of the Director of the Mayor's Office of Contract Compliance to determine the affirmative action capability of bidders, contractors and subcontractors and to recommend to the Manager the award of contracts to those bidders, contractors and subcontractors and suppliers who demonstrate the ability and willingness to comply with the terms of their contract.

**REGULATION NO. 6. PUBLICATION AND DUPLICATION:** Copies of these Rules and Regulations as amended by the Manager from time to time, shall as soon as practicable and after Notice being published will be made a part of all City Contracts.

**REGULATION NO. 7. NOTICE TO PROCEED:** Prior to issuance of Notice to Proceed a sign-off will be required of the Director of the Mayor's Office of Contract Compliance or his designee.

**REGULATION NO. 8. CONTRACTS WITH SUBCONTRACTORS:** To the greatest extent possible the contractor shall make a good faith effort to contract with minority contractors, subcontractors and suppliers for services and supplies by taking affirmative actions which include but are not limited to the following:

1. Advertise invitations for subcontractor bids in minority community news media.
2. Contact minority contractor organizations for referral of prospective subcontractors.
3. Purchase materials and supplies from minority material suppliers.

**REGULATION NO. 9. AGENCY REFERRALS:** it shall be no excuse that the union with which the contractor or subcontractor has an agreement providing for referral, exclusive or otherwise, failed to refer minority employees.

**REGULATION NO. 10. CLAUSES:** The Manager shall include the appropriate clauses in every contract and the contractor shall cause to be inserted in every subcontract the appropriate clauses:

1. **APPENDIX A:** City and County of Denver Equal Opportunity Clause-ALL CONTRACTS funded only with City & County of Denver monies.
2. **APPENDIX B:** Equal Opportunity Clause (11246)-ALL FEDERAL ASSISTED
3. **APPENDIX C:** Section 3-Assurance of Compliance-HUD ASSISTED PROJECTS.
4. **APPENDIX D:** Section 3-Clause-HUD ASSISTED PROJECTS.

All amendments to the appendices shall be included by reference.

**REGULATION NO. 11. SHOW CAUSE NOTICES:** When the Manager has reasonable cause to believe that a contractor has violated Article III, Division 2 of Chapter 28 of the Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen days why enforcement procedures, or other appropriate action to insure compliance, should not be instituted.

**REGULATION NO. 12. BID CONDITIONS-AFFIRMATIVE ACTION REQUIREMENTS-**

**EQUAL EMPLOYMENT OPPORTUNITY:**

**1. APPENDIX E:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as amended and published by the U.S. Department of Labor, Employment Standards Administration, Office of Federal Contract Compliance, shall be inserted verbatim for bidding specification for every non-exempt contract involving the use of Federal funds.

**2. APPENDIX F:**

The Bid Conditions- Affirmative Action Requirements-Equal Employment Opportunity as published by the Department of Public Works, City and County of Denver shall be inserted verbatim as bidding specifications for every non-exempt contract using City funds.

**APPENDIX A**

**CITY AND COUNTY OF DENVER EQUAL OPPORTUNITY CLAUSE-ALL CONTRACTS**

1. The contractor will not discriminate against any employee or applicant for employment because of race creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided, advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. Each contractor will comply with all provisions of Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and Director.
5. The contractor will furnish all information and reports required by Article III, Division 2, Chapter 28 of the Revised Municipal Code, and by rules, regulations and orders of the Manager and Director or pursuant thereto, and will permit access to his books, records, and accounts by the Manager, Director or their designee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders this contract may be cancelled, terminated., or suspended in whole or in part and the contractor may be declared ineligible for further City contracts in accordance with procedures authorized in

Article III, Division 2, Chapter 28 of the Revised Municipal Code, or by rules, regulations, or order of the Manager.

7. The contractor will include Regulation 12 Paragraph 2 and the provisions of paragraphs (1) through (6) in every subcontract or purchase order unless, exempted by rules, regulations, or orders of the Manager issued pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, so that such provisions will be binding upon each subcontractor or suppliers. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.  
The applicant further agrees to be bound by the above equal opportunity clauses with respect to its own employment practices when it participates in City contracts. The contractor agrees to assist and cooperate actively with the Manager and the Director in obtaining compliance of subcontractors and suppliers with the equal opportunity clause and the rules, regulations and relevant orders of the Manager, and will furnish the Manager and the Director such information as they may require for the supervision of compliance, and will otherwise assist the Manager and Director in the discharge of the City's primary responsibility for securing compliance. The contractor further agrees to refrain from entering into any contract or contract modification subject to Article III, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who has not demonstrated eligibility for, City contracts.  
The contractor will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the Manager and Director. In addition, the contractor agrees that failure or refusal to comply with these undertakings the Manager may take any or all of the following actions:
  - A. Cancellation, termination, or suspension in whole or in part of this contract.
  - B. Refrain from extending any further assistance to the applicant under the program with respect to which the failure occurred until satisfactory assurance of future compliance has been received from such applicant.
  - C. Refer the case to the City Attorney for appropriate legal proceedings.

**SUBCONTRACTS:** Each prime contractor or subcontractor shall include the equal opportunity clause in each of its subcontracts.

**APPENDIX F  
BID CONDITIONS  
AFFIRMATIVE ACTION REQUIREMENTS  
EQUAL EMPLOYMENT OPPORTUNITY**

For all Non-Exempt Construction Contracts to be Awarded by  
the City and County of Denver, Department of Public Works

**NOTICE**

EACH BIDDER, CONTRACTOR OR SUBCONTRACTOR (HEREINAFTER THE CONTRACTOR) MUST FULLY COMPLY WITH THE REQUIREMENTS OF THESE BID CONDITIONS AS TO EACH CONSTRUCTION TRADE IT INTENDS TO USE ON THIS CONSTRUCTION CONTRACT, AND ALL OTHER CONSTRUCTION WORK (BOTH CITY AND NON-CITY) IN THE DENVER AREA DURING THE PERFORMANCE OF THIS CONTRACT OR SUBCONTRACT. THE CONTRACTOR COMMITS ITSELF TO THE GOALS FOR MINORITY MANPOWER UTILIZATION, AS APPLICABLE, AND ALL OTHER REQUIREMENTS, TERMS AND CONDITION OF THESE BID CONDITIONS BY SUBMITTING A PROPERLY SIGNED BID.

THE CONTRACTOR SHALL APPOINT A COMPANY EXECUTIVE TO ASSUME THE RESPONSIBILITY FOR THE IMPLEMENTATION OF THE REQUIREMENTS, TERMS AND CONDITIONS OF THESE BID CONDITIONS.

MICHAEL D. MUSGRAVE  
Manager of Public Works  
City and County of Denver

**A. REQUIREMENTS --AN AFFIRM ATIVE ACTION PLAN:**

Contractors shall be subject to the provisions and requirements of these bid conditions including the goals and timetables for minority' and female utilization, and specific affirmative action steps set forth by the Office of Contract Compliance. The contractor's commitment to the goals for minority, and female utilization as required constitutes a commitment that it will make every good faith effort to meet such goals.

**1. GOALS AND TIMETABLES:**

The goals and timetables for minority<sup>1</sup> and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade are as follows:

**GOALS FOR MINORITY PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 21.7% - 23.5%  
Until Further Notice

**GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE**

From January 1, 1982  
to 6.9%  
Until Further Notice

The goals for minority and female utilization above are expressed in terms of hours of training and employment as a proportion of the total number of hours to be worked by the contractor's aggregate workforce, which includes all supervisory personnel, in each trade, on all projects for the City and County of Denver during the performance of its contract (i.e., The period beginning with the first day of work on the City and County of Denver funded construction contract and ending with the last day of work).

The hours of minority and female employment and training must be substantially uniform throughout the length of the contract in each trade and minorities and females must be employed evenly on each of a contractor's projects. Therefore, the transfer of minority or female employees from contractor to contractor or from project to project for the purpose of meeting the contractor's goals shall be a violation of these Bid Conditions.

If the contractor counts the nonworking hours of apprentices they must be employed by the contractor during the training period; the contractor must have made a commitment to employ apprentices at the completion of their training subject to the availability of employment opportunities; and the apprentices must be trained pursuant to training programs approved by the Bureau of Apprenticeship and Training.

**2. SPECIFIC AFFIRM ATIVE ACTION STEPS:**

No contractor shall be found to be in noncompliance solely on account of its failure to meet its goals, but will be given an opportunity to demonstrate that the contractor has instituted all the specific affirmative action steps specified and has made every good faith effort to make these steps work toward the attainment of its goals within the timetables, all to the purpose of expanding minority and female utilization in its

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<sup>1</sup> "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian-Americans, and American Indians, and includes both men and Minority women.

aggregate workforce. A contractor, who fails to comply with its obligation under the Equal Opportunity Clause of its contract and fails to achieve its commitments to the goals for minority and female utilization has the burden of proving that it has engaged in an Affirmative Action Program directed at increasing minority and female utilization and that such efforts were at least as extensive and as specific as the following:

- a. The contractor should have notified minority and female organizations when employment opportunities were available and should have maintained records of the organization's response.
- b. The contractor should have maintained a file of the names and addresses of each minority and female referred to it by any individual or organization and what action was taken with respect to each such referred individual, and if the individual was not employed by the contractor, the reasons. If such individual was sent to the union hiring hall for referral and not referred back by the union or if referred, not employed by the contractor, the file should have documented this and their reasons.
- c. The contractor should have promptly notified the Department of Public Works, and Mayor's Office of Contract Compliance when the union or unions with which the contractor has collective bargaining agreements did not refer to the contractor a minority or female sent by the contractor, or when the contractor has other information that the union referral process has impeded efforts to meet its goals.
- d. The contractor should have disseminated its EEO policy within its organization by including it in any employee handbook or policy manual; by publicizing it in company newspapers and annual reports and by advertising such policy at reasonable intervals in union publications. The EEO policy should be further disseminated by conducting staff meetings to explain and discuss the policy; by posting of the policy; and by review of the policy with minority and female employees.
- e. The contractor should have disseminated its EEO policy externally by informing and discussing it with all recruitment sources; by advertising in news media, specifically including minority and female news media; and by notifying and discussing it with all subcontractors.
- f. The contractor should have made both specific and reasonably recurrent written and oral recruitment efforts. Such efforts should have been directed at minority and female organizations, schools with substantial minority and female enrollment, and minority and female recruitment and training organizations within the contractor's recruitment area.
- g. The contractor should have evidence available for inspection that all tests and other selection techniques used to select from among candidates for hire, transfer, promotion, training, or retention are being used in a manner that does not violate the OFCCP Testing Guidelines in 41 CFR Part 60-3.
- h. The contractor should have made sure that seniority practices and job classifications do not have a discriminatory effect.
- i. The contractor should have made certain that all facilities are not segregated by race.

- j. The contractor should have continually monitored all personnel activities to ensure that its EEO policy was being carried out including the evaluation of minority and female employees for promotional opportunities on a quarterly basis and the encouragement of such employees to seek those opportunities.
- k. The contractor should have solicited bids for subcontracts from available minority and female subcontractors engaged in the trades covered by these Bid conditions, including circulation of minority and female contractor associations.

**NOTE:** The Director and the Mayor's Office of Contract Compliance will provide technical assistance on questions pertaining to minority and female recruitment sources, minority and female community organizations, and minority and female news media upon receipt of a request for assistance from a contractor.

3. **NON-DISCRIMINATION:**

In no event may a contractor utilize the goals and affirmative action steps required in such a manner as to cause or result in discrimination against any person on account of race, color, religion, sex, marital status, national origin, age, mental or physical handicap, political opinion or affiliation.

4. **COMPLIANCE AND ENFORCEMENT:**

In all cases, the compliance of a contractor will be determined in accordance with its obligations under the terms of these Bid Conditions. All contractors performing or to perform work on projects subject to these Bid Conditions hereby agree to inform their subcontractors in writing of their respective obligations under the terms and requirements of these Bid Conditions, including the provisions relating to goals of minority and female employment and training.

A. **Contractors Subject to these Bid Conditions:**

In regard to these Bid Conditions, if the contractor meets the goals set forth therein or can demonstrate that it has made every good faith effort to meet these goals, the contractor shall be presumed to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, the implementing regulations and its obligations under these Bid Conditions. In the event, no formal sanctions or proceedings leading toward sanctions shall be instituted unless the contracting or administering agency otherwise determines that the contractor is violating the Equal Opportunity Clause.

- 1. Where the Office of Contract Compliance finds that a contractor failed to comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code or the implementing regulations and the obligations under these Bid Conditions, and so informs the Manager, the Manager shall take such action and impose such sanctions, which include suspension, termination, cancellation, and debarment, as may be appropriate under the Ordinance and its regulations. When the Manager proceeds with such formal action it has the burden of proving that the contractor has not met the goals contained in these Bid Conditions. The contractor's failure to meet its goals shall shift to it the requirement to come forward with evidence to show that it has met the good faith requirements of these Bid Conditions.



2. The pendency of such proceedings shall be taken into consideration by the Department of Public Works in determining whether such contractor can comply with the requirements of Article 111, Division 2, Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Mayor's Office of Contract Compliance shall review the contractor's employment practices during the performance of the contract. If the Mayor's Office of Contract Compliance determines that the contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

**B. Obligations Applicable to Contractors:**

It shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority or female employees. Discrimination in referral for employment, even if pursuant to provisions of a collective bargaining agreement, is prohibited by the National Labor Relations Act, as amended, Title VI of the Civil Rights Act of 1964, as amended, and Article III, Division 2, Chapter 28 of the Revised Municipal Code. It is the policy of the Department of Public Works that contractors have a responsibility to provide equal employment opportunity, if they wish to participate in City and County of Denver contracts. To the extent they have delegated the responsibility for some of their employment practices to a labor organization and, as a result, are prevented from meeting their obligations pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, such Contractors cannot be considered to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, or its implementing rules and regulations.

**C. General Requirements**

Contractors are responsible for informing their subcontractors in writing regardless of tier, as to their respective obligations. Whenever a contractor subcontracts a portion of work in any trade covered by these Bid Conditions, it shall include these Bid Conditions in such subcontracts and each subcontractor shall be bound by these Bid Conditions to the full extent as if it were the prime contractor. The contractor shall not, however, be held accountable for the failure of its subcontractors to fulfill their obligations under these Bid Conditions. However, the prime contractor shall give notice to the Director of any refusal or failure of any subcontractor to fulfill the obligations under these Bid Conditions. A subcontractor's failure to comply will be treated in the same manner as such failure by a prime contractor.

1. Contractors hereby agree to refrain from entering into any contract or contract modification subject to Article 111, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who is determined not to be a "responsive" bidder for the City and County of Denver contracts pursuant to the Ordinance.
2. The contractor shall carry out such sanctions and penalties for violation of these Bid Conditions and the Equal Opportunity Clause including suspension, termination and cancellation of existing subcontracts and

debarment from future contracts as may be ordered by the Manager pursuant to Article 111, Division 2, Chapter 28 of the Revised Municipal Code and its implementing regulations.

3. Nothing herein is intended to relieve any contractor during the term of its contract from compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the Equal Opportunity Clause of its contract with respect to matters not covered in these Bid Conditions.
4. Contractors must keep such records and file such reports relating to the provisions of these Bid Conditions as shall be required by the Office of Contract Compliance.
5. Requests for exemptions from these Bid Conditions must be made in writing, with justification, to the Manager of Public Works, City and County Building, Room 379, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

## **Appendix No. 1**

### **Standard Federal Assurances and Nondiscrimination**

# APPENDIX 1(A)

## COMPLIANCE WITH NONDISCRIMINATION REQUIREMENTS

NOTE: As used below the term "Contractor" shall mean and include Concessionaire, and the term "sponsor" shall mean the "City." During the term of this Contract, the Contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

- 1. Compliance with Regulations.** The Contractor will comply with the Title VI List of Pertinent Non-Discrimination Statutes and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made part of this Agreement.
- 2. Nondiscrimination.** The Contractor, with regard to the work performed by it during this Agreement, will not discriminate on the grounds of race, creed, color, national origin, or sex in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and Regulations, including employment practices when the Agreement covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
- 3. Solicitations for Subcontractors, Including Procurements of Materials and Equipment.** In all solicitations, either by competitive Task Ordering or negotiation, made by the Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the Contractor's obligations under this Agreement and the Acts and Regulations relative to nondiscrimination on the grounds of race, color, or national origin.
- 4. Information and Reports.** The Contractor will provide all information and reports required by the Acts, Regulations or directives issued pursuant thereto and will permit access to its books, records, accounts other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration (FAA) to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the sponsor or the FAA, as appropriate, and will set forth what efforts it has made to obtain the information.
- 5. Sanctions for Noncompliance.** In the event of a Contractor's noncompliance with the nondiscrimination provisions of this Agreement, the sponsor will impose such Contract sanctions as it or the FAA may determine to be appropriate, including, but not limited to:

  - a. Withholding of payments to the Contractor under this Agreement until the Contractor complies, and/or;
  - b. Cancelling, terminating, or suspending this Agreement, in whole or in part.
- 6. Incorporation of Provisions.** The Contractor will include the provisions of paragraphs one (1) through six (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations or directives issued pursuant thereto. The

Contractor will take action with respect to any subcontract or procurement as the sponsor or the FAA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the sponsor to enter into such litigation to protect the interests of the sponsor. In addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

## APPENDIX 1(C)

### STANDARD FEDERAL ASSURANCES AND NONDISCRIMINATION IN CONSTRUCTION, MAINTENANCE, OPERATION OF FACILITIES

As used below, the term “sponsor” will mean City.

Concessionaire, for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as part of consideration hereof, does hereby covenant and agree, as a covenant running with the land that:

1. In the event facilities are constructed, maintained, or otherwise operated on the property described in this Agreement for a purpose for which a FAA activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the Concessionaire will maintain and operate such facilities and services in compliance with all requirements imposed by the Nondiscrimination Acts and Regulations listed in the Pertinent List of Nondiscrimination Authorities, as may be amended from time to time, such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
2. With respect to this Agreement, in the event of breach of any of the above Nondiscrimination covenants, sponsor will have the right to terminate this Agreement, and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if this Agreement had never been made or issued.

## APPENDIX 1(D)

### STANDARD FEDERAL ASSURANCES AND NONDISCRIMINATION IN CONSTRUCTION, USE, OR ACCESS TO FACILITIES

As used below, the term “sponsor” will mean City.

- A. Concessionaire for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as part of the consideration hereof, does hereby covenant and agree, as a covenant running with the land, that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the Concessionaire will use the Premises in compliance with all other requirements imposed by or pursuant to the List of Pertinent Nondiscrimination Authorities.
- B. With respect this Agreement, in the event of breach of any of the above nondiscrimination covenants, sponsor will have the right to terminate this Agreement and to enter, re-enter, and repossess said land and the facilities thereon, and hold the same as if this Agreement had never been made or issued.

## APPENDIX 1(E)

### TITLE VI LIST OF PERTINENT NONDISCRIMINATION AUTHORITIES

As used below, the term "Contractor" will mean and include Concessionaire and the term "sponsor" will mean City.

During the performance of this Agreement, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor") agrees to comply with the following nondiscrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252), (prohibits' discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination In Federally-Assisted Programs of The Department of Transportation-Effectuation of Title VI of The Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601 ), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S. C. § 794 *et seq.*), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.*), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC§ 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 1 00-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and Contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 -12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;



- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S. C. 1681 et seq).

## APPENDIX 2

### DISADVANTAGED BUSINESS ENTERPRISES- REQUIRED STATEMENTS

As used below, the term "Contractor" will mean and include Concessionaire and the term "sponsor" will mean City.

**Contract Assurance (§ 26.13)** – The Contractor or subcontractor will not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor will carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT assisted Contracts. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy, as the recipient deems appropriate.

**Prompt Payment (§26.29)** – The prime Contractor agrees to pay each subcontractor under this prime Contract for satisfactory performance of its Contract no later than thirty (30) days from the receipt of each payment the prime Contractor receives from Contractor. The prime Contractor agrees further to return retainage payments to each subcontractor within thirty (30) days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the sponsor. This clause applies to both DBE and non-DBE subcontractors.

**Contract Control Number:** PLANE-201734681-00

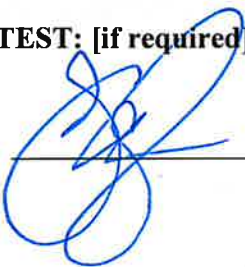
**Contractor Name:** ThyssenKrupp Elevator Corporation

By: 

Name: Aubrey Bigelow  
(please print) Contract Analyst

Title: \_\_\_\_\_  
(please print)

**ATTEST: [if required]**

By: 

Name: David Cuzelis  
(please print) Contract Analyst

Title: \_\_\_\_\_  
(please print)



**Contract Control Number:**

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of

SEAL

**CITY AND COUNTY OF DENVER**

ATTEST:

By \_\_\_\_\_

\_\_\_\_\_

APPROVED AS TO FORM:

REGISTERED AND COUNTERSIGNED:

By \_\_\_\_\_

By \_\_\_\_\_

By \_\_\_\_\_

