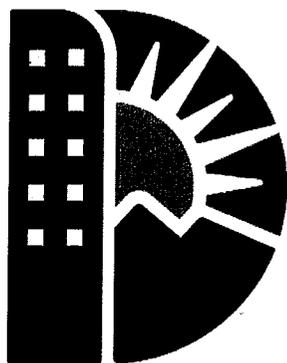


# CITY AND COUNTY OF DENVER

STATE OF COLORADO



**DENVER**<sup>®</sup>  
THE MILE HIGH CITY

DEPARTMENT OF PUBLIC WORKS/

## **BID Document PACKAGE**

**Contract No. 201100583**

**Formerly CE00767**

---

**CHERRY CREEK TRANSFER STATION  
ADDITIONS**

**December 7, 2010**



**DENVER**  
THE MILE HIGH CITY

**Department of Public Works  
Engineering Division**

Capital Projects Management – Dept. 506  
Right-of-Way Services – Dept. 507  
Policy and Planning – Dept. 509  
Traffic Engineering Services – Dept. 508

201 West Colfax Avenue  
Denver, CO 80202  
[www.Work4Denver.com](http://www.Work4Denver.com)

**Ash & White Construction  
dba White Construction Group, LTD.  
18 S. Wilcox Street Ste. 100  
Castle Rock, CO 80104**

**NOTICE OF APPARENT LOW BIDDER**

The MANAGER OF PUBLIC WORKS has considered the Bids submitted on **January 13, 2011** for work to be done and materials to be furnished in and for:

**PROJECT No. 201100583(Formerly CE00767) CHERRY CREEK TRANSFER STATION  
ADDITIONS**

as set forth in detail in the Contract Documents for the City and County of Denver, Colorado. It appears that your Bid is fair, equitable, and to the best interest of the City and County; therefore, said Bid is hereby accepted at the bid price contained herein, subject to the approval and execution of the Contract Documents by the City in accordance with the Charter of the City and County of Denver, and to your furnishing the items specified below. The award is based on the **base bid plus Alternates 1, 3 and 4 the total estimated cost thereof being One Million Eight Hundred Ten Thousand Dollars and No Cents (\$1,810,000.00).**

It will be necessary for you to appear forthwith at the office of the Department of Public Works, Contract Administration, 201 W. Colfax Ave., Dept 614, Denver, Colorado 80202, to receive the said Contract Documents, execute the same and return them to the Department of Public Works, Contract Administration within the time limit set forth in the Bid Proposal.

In accordance with the requirements set forth in the Contract Documents, you are required to furnish the following documents:

- a. Insurance Certificates: General Liability and Automotive Liability, Workman's Compensation and Employer Liability;
- b. One original plus two copies of the Power of Attorney relative to Performance and/or Payment Bond; and,

All construction Contracts made and entered into by the City and County of Denver are subject to Affirmative Action and Equal Opportunity Rules and Regulations, as adopted by the Manager of Public Works, and each contract requiring payment by the City of one-half million dollars (\$500,000.00) or more shall first be approved by the City Council acting by ordinance and in accordance with Section B1.12.2 of the Charter of the City and County of Denver.

Prior to issuance of Notice to Proceed, all Equal Opportunity requirements must be completed. Additional information may be obtained by contacting the Director of Contract Compliance at (720-913-1700).

**NOTICE OF APPARENT LOW BIDDER**

PROJECT NO. CE00767

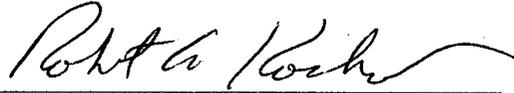
Page 2

The Bid Security submitted with your Bid, will be returned upon execution of the Contract and furnishing of the Performance Bond. In the event you should fail to execute the Contract and to furnish the performance Bond within the time limit specified, said Bid Security will be retained by the City and County of Denver as liquidated damages, and not as a penalty for the delay and extra work caused thereby.

Dated at Denver, Colorado this 18th day of April 2011.

CITY AND COUNTY OF DENVER

By



*for*

George Delaney  
Manager of Public Works

MK/joa

cc: H. Woods (CAO), Gallagher (AUD), Schellinger (Treasury/Tax Compliance), DSBO Inbox, Robert Alson, Steve Forvilly, Merritt (PW-Aud), File.

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

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FOR  
BID FORM AND SUBMITTAL PACKAGE**

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Joint Venture Eligibility Form	BF-17 through BF-19
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Bidder / Contractor / Vendor / Proposer Disclosure Form	BF-21 through BF-23



***This Checklist is provided solely for the assistance of the bidders, and need not be returned by Bidders with your BID FORM PACKAGE.***

**BIDDER'S CHECKLIST**

These forms comprise the Bid Form and Submittal Package. Designated forms must be completed and turned in at the time of Bid Opening. Bidders should refer to the Contract Documents, particularly the Instructions to Bidders, accompanying this package, in completing these forms.

FORM/ PAGE NO.	COMMENTS	COMPLETE
BF-4 – BF-5	a.) Acknowledgment signature and attestation required.	<input type="checkbox"/>
BF-6+	a.) Fill in individual bid item dollars and totals in Numerical figures only b.) Complete all blanks	<input type="checkbox"/> <input type="checkbox"/>
BF-7	a.) Write out bid total or bid totals in words and figures in the blank form space(s) provided	<input type="checkbox"/>
BF-8	a.) List all subcontractors who are performing work on this project	<input type="checkbox"/>
BF-9 – BF-10	a.) Fully complete List of Proposed Minority /Woman Business Enterprise Bidders, Subcontractors, Suppliers, Manufacturers, or Brokers – check appropriate boxes.	<input type="checkbox"/>
BF-11	a.) Complete all blanks b.) If Addenda have been issued, complete bottom section.	<input type="checkbox"/> <input type="checkbox"/>
BF-12	a.) Complete appropriate sections - signature(s) required. b.) If corporation, then corporate seal required.	<input type="checkbox"/> <input type="checkbox"/>
BF-13	a.) Fully complete Commitment to M/WBE, DBE or SBE Participation	<input type="checkbox"/>
BF-16	a.) If applicable, fully complete Joint Venture Affidavit	<input type="checkbox"/>
BF-17 – BF-19	a.) If applicable, fully complete Joint Venture Eligibility Form	<input type="checkbox"/>

BF-20	a.) Fill in all Bid Bond blanks b.) Signatures required c.) Corporate Seal if required d.) Dated e.) Attach Surety Agents Power of Attorney or Certified or cashier's check made out to the Manager of Revenue referencing Bidder's Company and CE Number.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
BF-21-BF-23	a.) Per form Instructions, fully complete and sign the Bidder/Contractor/Vendor/Proposer Disclosure form as required by IB-24. Ensure form is complete and signed.	<input type="checkbox"/>

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**BID FORM AND SUBMITTAL PACKAGE ACKNOWLEDGMENT**

CONTRACT NO. CE00767

**CHERRY CREEK TRANSFER STATION ADDITIONS**

**BIDDER:** Ash & White Construction Co., d.b.a. White Construction Group, Ltd.

**ADDRESS:** 18 S Wilcox St., Ste. 100  
Castle Rock, CO 80104  
\_\_\_\_\_  
\_\_\_\_\_

The undersigned bidder states that the undersigned bidder has received and had an opportunity to fully and thoroughly examine a complete set of the Contract Documents for **Contract No. CE00767, CHERRY CREEK TRANSFER STATION ADDITIONS**, made available to the undersigned bidder pursuant to Notice of Invitation for Bids dated December 7, 2010.

The undersigned bidder acknowledges that a complete and final set of the Contract Documents for the referenced Project, the components of which are identified below, are bound and maintained as the record set of Contract Documents by the Contract Administration Division of the Department of Public Works and that this Record Set is available for examination by the undersigned bidder.

The undersigned bidder, having thoroughly examined each of the components identified below and contained in Contract Documents, **HEREBY SUBMITS THIS BID FORM AND SUBMITTAL PACKAGE**, fully understanding that the Contract Documents, as defined in Paragraph 1 of the contract, including this executed Bid Form and Submittal Package, constitute all of the terms, conditions and requirements upon which this submission is based and further understanding that, by submission of this Bid Form and Submittal Package, the City shall rely on the representations and commitments of the undersigned bidder contained herein.

The following completed documents comprising this Bid Form and Submittal Package will be included with and, by this reference, are expressly incorporated into the Contract Documents specified at Paragraph 1 of the Contract:

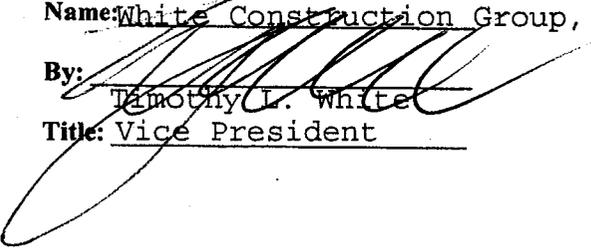
- Bid Form and Submittal Package Acknowledgment Form
- Bid Form
- List of Proposed Minority/Woman Owned Business Enterprise(s)
- Commitment to Minority/Woman Owned Business Enterprise Participation
- Minority/Woman Owned Business Enterprise(s) of Intent
- Joint Venture Affidavit (if applicable)
- Joint Venture Eligibility Form (if applicable)
- Bid Bond
- Bidder / Contractor / Vendor / Proposer Disclosure Form
- Certificate of Insurance

The following designated documents constitute that portion of the Contract Documents made available by the Notice of Invitation for Bids, but not included in the Bid Form and Submittal Package:

Notice of Invitation for Bids  
Instructions to Bidders  
Addenda (as applicable)  
Equal Employment Opportunity Provisions (Appendix A and Appendix F)  
Contract Form  
General Contract Conditions  
Special Contract Conditions  
Performance and Payment Bond  
Notice to Apparent Low Bidder  
Notice to Proceed  
Contractor's Certification of Payment Form  
Final/Partial Lien Release Form  
Final Receipt  
Change Orders (as applicable)  
Federal Requirements (as applicable)  
Prevailing Wage Rate Schedule(s)  
Technical Specifications  
Contract Drawings  
Accepted Shop Drawings

The undersigned bidder expressly assumes responsibility for the complete contents of these designated documents as bound together with the Bid Form and Submittal Package submitted herewith and designated the Contract Documents.

IN WITNESS WHEREOF, the undersigned bidder has signed personally or by duly authorized officer or agent and duly attested.

**BIDDER:**  
Ash & White Construction Co.,  
**Name:** ~~White Construction Group, Ltd.~~  
**By:**   
**Title:** Vice President

**ATTEST:**

**By:** 

[SEAL]

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**BID FORM**

**CONTRACT NO. CE00767**

**CHERRY CREEK TRANSFER STATION ADDITIONS**

**BIDDER** Ash & White Construction Co., d.b.a. White Construction Group, Ltd.

**TO:** The Manager of Public Works  
City and County of Denver  
c/o Contract Administration  
201 West Colfax, Dept. 614  
Denver, Colorado 80202

The Undersigned Bidder, having examined the plans, technical specifications, and remainder of the proposed Contract Documents as designated and enumerated in the General and Special Contract Conditions and any and all addenda thereto; having investigated the location of and conditions affecting the proposed Work; and being acquainted with and fully understanding the extent and character of the Work covered by this bid, and all factors and conditions affecting or which may be affected by Work, HEREBY SUBMITS THIS BID, pursuant to an advertisement of a Notice of Invitation for Bids as published on **December 7, 2010**, to furnish all required materials, tools, appliances, equipment and plant; to perform all necessary labor and to undertake and complete: **CONTRACT NO. CE00767, CHERRY CREEK TRANSFER STATION ADDITIONS**, in Denver, Colorado, in full accordance with and conformity to the Plans, Technical Specifications, and Contract Documents hereto attached or by reference made a part hereof, at and for the following price(s) set forth on this Bid Form.

The following documents, which taken as a whole constitute the Contract Documents for this Project, and which are incorporated herein, by reference, were made available to the Bidder as provided in the Advertisement of Notice of Invitation for Bids, were received by the bidder, and form the basis for this bid:

- Advertisement of Notice of Invitation for Bids*
- Instructions to Bidders*
- Commitment to M/WBE Participation*
- Article III, Divisions 1 and 3 of Chapter 28, D.R.M.C.*
- Bid Bond*
- Addenda (as applicable)*
- Equal Employment Opportunity Provisions (Appendix A and Appendix F)*
- Bid Form*
- Contract Form*
- General Contract Conditions*
- Special Contract Conditions*
- Performance and Payment Bond*
- Notice to Apparent Low Bidder*
- Notice to Proceed*
- Contractor's Certification of Payment Form*
- Final/Partial Lien Release Form*
- Final Receipt*
- Change Orders (as applicable)*
- Federal Requirements (as applicable)*
- Prevailing Wage Rate Schedule(s)*
- Technical Specifications*
- Contract Drawing*
- Accepted Shop Drawings*
- Certificate of Insurance*

Item No.	Description and Price	Estimated Quantity	Estimated Cost
Base Bid -	Fleet Maintenance Building Truck Wash Enclosure	1 Lump Sum	\$ <u>971,000</u>
Alternate 1 -	Add Truck Wash Equipment	1 Lump Sum	\$ <u>175,000</u>
Alternate 2 -	Not Used		
Alternate 3 -	Remodel Offices in Fleet Maintenance Building	1 Lump Sum	\$ <u>146,000</u>
Alternate 4 -	Addition to Trash Transfer Building	1 Lump Sum	\$ <u>518,000</u>

Total Base Bid Amount of:

Nine hundred & Seventy One thousand

Dollars (\$) 971,000

Alternate 1 (Add Truck Wash Equipment):

One hundred & Seventy five thousand

Dollars (\$) 175,000

Alternate 3 (Remodel Offices in Fleet Maintenance Building):

one hundred forty six thousand

Dollars (\$) 146,000

Alternate 4 (Addition to Trash Transfer Building):

five hundred eighteen thousand

Dollars (\$) 518,000

If the Manager mails a written Notice of Apparent Low Bidder, addressed to the Bidder's business address stated on this Bid Form, the Undersigned Bidder shall, in accordance with the Contract Documents, be ready to, and shall, within five (5) days after the date of the Notice: (i) execute the attached form of Contract in conformity with this bid; (ii) furnish the required proofs of insurance; and (iii) furnish the required bond or bonds in the sum of the full amount of this bid, executed by a surety company acceptable to the Manager.

The Hanover Insurance Co, a corporation of the State of New Hampshire, is hereby offered as Surety on said bond. If such surety is not approved by the Manager, another and satisfactory surety company shall be furnished.

Enclosed with this bid is a bid guarantee, as defined in the attached Instructions to Bidders, in the amount of 5%. The Undersigned Bidder agrees that the entire amount of this bid guarantee is to be paid to and become the property of the City as liquidated damages, and not as a penalty, if: (i) the bid is considered to be the best by the City; (ii) the City notifies the Undersigned Bidder that it is the Apparent Low Bidder; and (iii) the Undersigned Bidder fails to execute the Contract in the form prescribed or to furnish the required bond and proofs of insurance, within five (5) days after the date of such notification.

The following persons, firms or corporations are interested with the Undersigned Bidder in this bid:

Name: \_\_\_\_\_ Name: \_\_\_\_\_

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

If there are no such persons, firms, or corporations, please so state in the following space: None

The Undersigned Bidder proposes to subcontract the following Work in accordance with General Contract Conditions, Title 5, SUBCONTRACTS, and represents that, to the greatest degree practical, all subcontractors known at the time of bid submittal have been identified.

Item of Work	Percent (%) of Total; Work.	Proposed Subcontractor and Address
Demo	1.2%	Superior : Denver, CO
Earthwork	26%	Dyer : Parker, CO
Concrete	11%	RG Concrete Dr B&D Foundation
Architect Re. concrete	6%	Stress con, Denver, CO
Structural Steel	4.3%	Independent Welding
Final Clean	.252%	All Tech Janitorial
Painting	.673%	Kinnard
Hvac	7.104%	NM Industrial
Electrical	6.898%	Rink Electrical

(Copy this page if additional room is required.)



Office of Economic Development  
 Division of Small Business Opportunity  
 Compliance Unit  
 201 West Colfax Avenue, Dept. 907  
 Denver, CO 80202  
 Phone: 720.913.1999  
 Fax: 720.913.1803

**List of Proposed Minority/Woman Business Enterprise Bidders, Subcontractors, Suppliers (Manufacturers) or Brokers**

City and County of Denver Contract No. CE00767

The undersigned Bidder proposes to utilize the following Minority or Woman Business Enterprise (MBE/WBE) for the project. All listed firms are **CURRENTLY** certified by the City and County of Denver. Only the level of MBE or WBE participation listed at the bid opening will count toward satisfaction of the project goal. Only bona fide commissions may be counted for Brokers. MBE or WBE prime bidders must detail their bid information below. Please copy and attach this page to list additional MBEs or WBEs for this project.

**Prime Bidder**

Business Name: White Construction Group  
 Address: 18 S. Wilcox Street, Castle Rock Contact Person: Doug Decker  
 Type of Service: Prime Dollar Amount: \$: \_\_\_\_\_ Percent of Project: \_\_\_\_\_

**MBE or WBE Prime Bidder**

Business Name: \_\_\_\_\_  
 Address: \_\_\_\_\_ Contact Person: \_\_\_\_\_  
 Type of Service: \_\_\_\_\_ Dollar Amount: \$: \_\_\_\_\_ Percent of Project: \_\_\_\_\_

**Subcontractors, Suppliers, Manufacturers or Brokers (check one box)**

Subcontractor (v) <input checked="" type="checkbox"/>	Supplier (v) <input type="checkbox"/>	Manufacturer (v) <input type="checkbox"/>	Broker (v) <input type="checkbox"/>
---	---------------------------------------	---	-------------------------------------

Business Name: All Tech Sanitorial Service  
 Address: 10023 Franklin St. Thornton Type of Service: Final Cleaning  
 Contact Person: Susan Ramirez Dollar Amount: \$: 2450 Percent of Project: .52

Subcontractor (v) <input checked="" type="checkbox"/>	Supplier (v) <input type="checkbox"/>	Manufacturer (v) <input type="checkbox"/>	Broker (v) <input type="checkbox"/>
---	---------------------------------------	---	-------------------------------------

Business Name: Kinnards Painting  
 Address: 1590 Roslyn Street, Denver Type of Service: Painting  
 Contact Person: Kinnard Carter Dollar Amount: \$: 6,539 Percent of Project: 6.73

Subcontractor (v) <input checked="" type="checkbox"/>	Supplier (v) <input type="checkbox"/>	Manufacturer (v) <input type="checkbox"/>	Broker (v) <input type="checkbox"/>
---	---------------------------------------	---	-------------------------------------

Business Name: Independent Welding  
 Address: PO Box 21165, Denver Type of Service: Structural Steel  
 Contact Person: Jared Rodriguez Dollar Amount: \$: 41,950 Percent of Project: 4.39

**Subcontractors, Suppliers, Manufacturers or Brokers (check one box)**

<input checked="" type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
---	---------------------------------------	---	-------------------------------------

Business Name: **NM Industrial**

Address: **1001 W. 42nd, Denver** Type of Service: **HVAC**

Contact Person: **Nathan Martinez** Dollar Amount: \$ **1,000** Percent of Project: **7.10%**

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name: **Rocky Mountain Empire Electric**

Address: **15417 E Hinnsdale Circle** Type of Service: **Electrical**

Contact Person: **Jared Medao** *Centennial* Dollar Amount: \$ **17,000** Percent of Project: **6.8%**

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name:

Address:

Contact Person:

Type of Service:

Dollar Amount: \$:

Percent of Project:

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name:

Address:

Contact Person:

Type of Service:

Dollar Amount: \$:

Percent of Project:

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name:

Address:

Contact Person:

Type of Service:

Dollar Amount: \$:

Percent of Project:

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name:

Address:

Contact Person:

Type of Service:

Dollar Amount: \$:

Percent of Project:

<input type="checkbox"/> Subcontractor (√)	<input type="checkbox"/> Supplier (√)	<input type="checkbox"/> Manufacturer (√)	<input type="checkbox"/> Broker (√)
--	---------------------------------------	---	-------------------------------------

Business Name:

Address:

Contact Person:

Type of Service:

Dollar Amount: \$:

Percent of Project:

The undersigned Bidder hereby certifies that the aforementioned subcontractors and suppliers 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 aforementioned M/WBE(s) was furnished to the Bidder prior to the bid opening. The undersigned Bidder agrees that after the bid opening, it shall submit to the City an executed and completed W/MBE "Letter of Intent" in three working days (3) on each of its M/WBE subcontractors. The "Letter of Intent" form is contained in the Contract Documents.

The undersigned Bidder acknowledges the right of the City to reject any or all bids submitted, to waive informalities in bids and to re-advertise this Project for bids.

The undersigned certifies that it has carefully checked all works and figures and all statements made in these Bid Forms.

This bid is submitted upon the declaration that neither, I (we), nor, to the best of my (our) knowledge, none of the members of my (our) firm or company have either directly or indirectly entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this bid.

Business Address of Bidder: 18 S Wilcox St., Ste. 100

City, State, Zip Code: Castle Rock, CO 80104

Telephone Number of Bidder: 303-688-6924 Fax No. 303-688-6265

Social Security or Federal Employer ID Number of Bidder: 84-0991003

Name and location of the last work of this kind herein contemplated upon which the Bidder was engaged:  
Rifle Parks & Maintenance Facility

For information relative thereto, please refer to:

Name: Tom Whittmore

Title: Parks Director

Address: 202 Railroad Avenue, Rifle, CO 81658

The undersigned acknowledges receipt, understanding, and full consideration of the following addenda to the Contract Documents:

Addenda Number 1 Date 1/6/2011

Addenda Number \_\_\_\_\_ Date \_\_\_\_\_

Addenda Number \_\_\_\_\_ Date \_\_\_\_\_

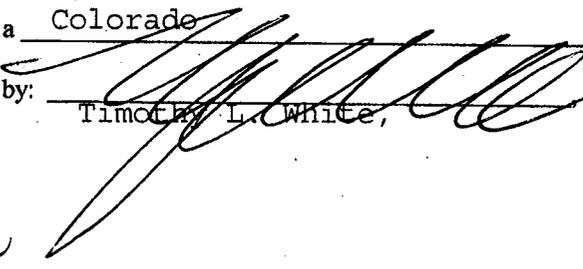
Dated this 13th day of January, 2011.

**Signature of Bidder:**

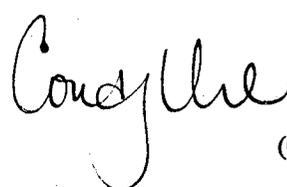
If an Individual: \_\_\_\_\_ doing business  
as \_\_\_\_\_

If a Partnership: \_\_\_\_\_

If a Corporation: \_\_\_\_\_ by: \_\_\_\_\_ General Partner.  
Ash & White Construction Co., d.b.a.  
White Construction Group, Ltd.

a Colorado Corporation,  
by:  its President.  
Timothy L. White,

Attest:



Secretary

(Corporate Seal)

**If a Joint Venture, signature of all Joint Venture participants.**

Firm: \_\_\_\_\_

Corporation ( ), Partnership ( ) or ( ) Limited Liability Company

By: \_\_\_\_\_ (If a Corporation)  
Attest: \_\_\_\_\_  
Title: \_\_\_\_\_ Secretary (Corporate Seal)

Firm: \_\_\_\_\_

Corporation ( ), Partnership ( ) or ( ) Limited Liability Company

By: \_\_\_\_\_ (If a Corporation)  
Attest: \_\_\_\_\_  
Title: \_\_\_\_\_ Secretary (Corporate Seal)

Firm: \_\_\_\_\_

Corporation ( ), Partnership ( ) or ( ) Limited Liability Company

By: \_\_\_\_\_ (If a Corporation)  
Attest: \_\_\_\_\_  
Title: \_\_\_\_\_ Secretary (Corporate Seal)



DENVER  
THE MILE HIGH CITY

### Commitment to Minority and Women Business Enterprise Participation

Office of Economic Development  
Division of Small Business Opportunity  
Compliance Unit

Colfax Avenue, Dept. 907  
Denver, CO 80202  
Phone: 720-913-1999  
Fax: 720-913-1803

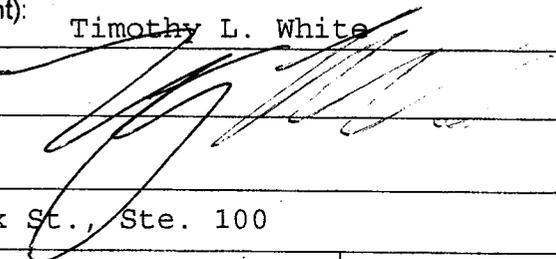
The undersigned has satisfied the MBE and/or WBE participation requirements in the following manner. (Please check the appropriate box).

The Bidder is committed to a minimum of 19 % MBE and/or WBE utilization on the project, and will submit Letters of Intent for each MBE or WBE listed in the Bid Forms, within three (3) working days after the bid opening.

The Bidder is unable to meet the project goal of \_\_\_\_\_% MBE/WBE, but is committed to a minimum of \_\_\_\_\_% MBE/WBE utilization on the project. The Bidder understands that they must submit a detailed statement of their good faith efforts, which occurred prior to the bid opening, to meet the project goal, and must submit Letters of Intent for each MBE or WBE listed in the Bid Forms, within three (3) working days after the bid opening.

Bidder (Name of Firm): Ash & White Construction Co., d.b.a.  
White Construction Group, Ltd.

Firm's Representative (Please print): Timothy L. White

Signature (Firm's Representative): 

Title: President

Address: 18 South Wilcox St., Ste. 100

City: Castle Rock

State: CO

Zip: 80104

Phone: 303-688-6924

Fax: 303-688-6265



**DENVER**  
THE MILE HIGH CITY

Office of Economic Development  
Division of Small Business Opportunity  
Compliance Unit  
201 West Colfax Ave., Dept. 907  
Denver, CO 80202  
Phone: 720-913-1999 Fax: 720-913-1803

**LETTER OF INTENT (LOI)**

**INSTRUCTIONS FOR COMPLETION & SUBMISSION:**

- All lines must be completed or marked N/A for Not Applicable
- Submit the attached completed checklist with this letter
- Email to [dsbo@denvergov.org](mailto:dsbo@denvergov.org), **OR**
- Fax: 720-913-1803, **OR**
- Hand-Delivery: Office Economic Dev. 7<sup>th</sup> Fl., "DSBO Inbox"

<b>Contract No.:</b> CE00767		<b>Project Name:</b> Cherry Creek Transfer Station Adds	
<b>A. The Following Section is To Be Completed by the Bidder/Consultant</b> <b>This Letter of Intent Must be Signed by the Bidder/Consultant and M/WBE, SBE or DBE</b>			
Name of Bidder/Consultant:		Phone:	
Contact Person:	Email:	Fax:	
Address:	City:	State:	Zip:
<b>B. The Following Section is To Be Completed by the M/WBE, SBE or DBE at any Tier</b> <b>This Letter of Intent Must be Signed by the M/WBE, SBE or DBE and Bidder/Consultant</b>			
Name of Certified Firm:		Phone:	
Contact Person:	Email:	Fax:	
Address:	City:	State:	Zip:
Please check the designation which applies to the certified firm:	<input type="checkbox"/> MBE/WBE (N)	<input type="checkbox"/> SBE (N)	<input type="checkbox"/> DBE (N)
<b>Indirect Utilization:</b> If this M/WBE, SBE or DBE is not a direct first tier subcontractor/subconsultant, supplier or broker to the Bidder/ Consultant, please indicate the name of the subcontractor/subconsultant, supplier or broker which is utilizing the participation of this firm:			
<b>A Copy of the M/WBE, SBE or DBE Letter of Certification must be Attached</b>			
Identify the scope of the work to be performed or supply item that will be provided by the M/WBE/SBE/DBE. <b>On unit price bids only. Identify which bid line items the M/WBE/SBE/DBEs scope of work or supply corresponds to.</b>			
<input type="checkbox"/>	Subcontractor/Subconsultant (N)	<input type="checkbox"/>	Supplier (N)
<input type="checkbox"/>		<input type="checkbox"/>	Broker (N)
<b>Bidder</b> intends to utilize the aforementioned M/WBE, SBE or DBE for the Work/Supply described above. The cost of the work and percentage of the total subcontractor M/WBE, SBE or DBE bid amount is:			
\$			%
<b>Consultant</b> intends to utilize the aforementioned M/WBE, SBE or DBE for the Work/Supply described above. The percentage of the work of the total subconsultant M/WBE, SBE or DBE will perform is:			
			%
If the fee amount of the work to be performed is requested, the fee amount, is:			
		\$	
Bidder/Consultant's Signature:		Date:	
Title:			
M/WBE, SBE or DBE Firm's Signature:		Date:	
Title:			
If the above named Bidder/Consultant is not determined to be the successful Bidder/Consultant, this Letter of Intent shall be null and void.			

COMP-FRM-012 Revised 11/30/10

## Letter of Intent (LOI) Checklist

*All lines must be completed or marked N/A for Not Applicable  
Submit the attached completed checklist with this letter.*

<b>Completed ✓</b>	
<input type="checkbox"/>	Project Number & Project Name
<input type="checkbox"/>	<b>Section A:</b> Name of Bidder/Consultant, Contact Person, Address, City, State, Zip, Phone, Email
<input type="checkbox"/>	<b>Section B:</b> Name of Certified Firm, Contact Person, Address, City, State, Zip, Phone, Email
<input type="checkbox"/>	Designation checked for MBE/WBE, SBE or DBE
<input type="checkbox"/>	<b>Indirect Utilization:</b> Name of subcontractor/subconsultant, supplier or broker is indicated if using the participation of a 2 <sup>nd</sup> tier subcontractor/subconsultant, supplier or broker.
<input type="checkbox"/>	Scope of work performed or item supplied by M/WBE, SBE or DBE
<input type="checkbox"/>	Line items performed, if line-item bid.
<input type="checkbox"/>	Copy of M/WBE, SBE or DBE Letter of Certification Attached
<input type="checkbox"/>	Designation checked for Subcontractor/Subconsultant, Supplier or Broker
	<b>If project is a hard bid...</b>
<input type="checkbox"/>	Bidder has indicated dollar amount for value of work going to Subcontractor/ Subconsultant, Supplier or Broker
<input type="checkbox"/>	Bidder has indicated percentage for value of work going to Subcontractor/ Subconsultant, Supplier or Broker
	<b>If project is an RFP/RFQ...</b>
<input type="checkbox"/>	Consultant has indicated percentage for value of work going to Subcontractor/ Subconsultant, Supplier or Broker Name & contact name for MWBE.
<input type="checkbox"/>	Fee amount if fee amount of work to be performed is requested.
<input type="checkbox"/>	Bidder/Consultant's Signature, Title & Date
<input type="checkbox"/>	M/WBE, SBE or DBE Firm's Signature, Title and Date

<b>Select One ✓</b>	<b>SUBMITTED VIA...</b> (Bidder/Consultant is strongly urged to deliver the LOI via one of the methods below. Delivery to any other point cannot be guaranteed timely delivery.)
<input type="checkbox"/>	Email to DSBO@denvergov.org
<input type="checkbox"/>	Fax to 720-913-1803
<input type="checkbox"/>	Hand Delivery to Office of Economic Development, 7 <sup>th</sup> Floor, "DSBO Inbox"

**The complete and accurate information that is required for the Letter of Intent is based on the following sections of the Ordinance: Section 28-63 and Section 28-68. Failure to complete this information on the Letter of Intent (LOI) may automatically deem a bid or proposal non-responsive.**



DENVER THE MILE HIGH CITY

Office of Economic Development
Division of Small Business Opportunity
Compliance Unit
201 West Colfax Avenue, Dept. 907
Denver, CO 80202
Phone: 720-913-1999
Fax: 720-913-1803

Joint Venture Affidavit

"The Undersigned swears that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operation of our joint venture and the intended participation by each joint venturer in the undertaking.. Further, the Undersigned covenant and agree to provide the City current, complete, and accurate information regarding actual joint venture work and the payment thereof and any proposed changes in any of the joint venture arrangements and to permit the audit and examination of the books, records, and files of the joint venture, by authorized representatives of the City or Federal funding agency, if applicable. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statements".

Name of Firm:
Print Name: Title
Signature: Date:

Notary Public
County of State of My Commission Expires:
Subscribed and sworn before me this
day of , 20
Notary Signature:
Address:
Notary Seal

Name of Firm:
Print Name: Title
Signature: Date:

Notary Public
County of State of My Commission Expires:
Subscribed and sworn before me this
day of , 20
Notary Signature:
Address:
Notary Seal

Name of Firm:
Print Name: Title
Signature: Date:

Notary Public
County of State of My Commission Expires:
Subscribed and sworn before me this
day of , 20
Notary Signature:
Address:
Notary Seal



**DENVER**  
THE MILE HIGH CITY

## JOINT VENTURE ELIGIBILITY FORM

Office of Economic Development  
Division of Small Business Opportunity  
Compliance Unit  
201 West Colfax Ave. Dept. 907  
Denver, CO 80202  
Phone: (720) 913-1999  
Fax: (720) 913-1803

**Joint Venture means** an association of two (2) or more business enterprises to constitute a single business enterprise to perform a City construction or professional design and construction services contract for which purpose they combine their property, capital, efforts, skills and knowledge, and in which each joint venturer is responsible for a distinct, clearly defined portion of the work of the contract, performs a commercially useful function, and whose share in the capital contribution, control, management responsibilities, risks and profits of the joint venture are equal to its ownership interest. Joint ventures must have an agreement in writing specifying the terms and conditions of the relationships between the joint venturers and their relationship and responsibility to the contract.

The Division of Small Business Opportunity (DSBO) requires the following information be provided from participants of a prospective joint venture, to assist DSBO in evaluating the proposed joint venture. This Joint Venture Eligibility form and the Joint Venture Affidavit apply if SBEs, MBEs, WBEs or DBEs participate in this joint venture.

Please return this form, the Joint Venture Affidavit and a copy of your Joint Venture Agreement to: Division of Small Business Opportunity, 201 West Colfax Avenue, Denver, CO 80202, at least five (5) days prior to bid opening or proposal.

If you have questions regarding this process, please contact DSBO at 720-913-1999.

Name:		Contact Person:	
Address:			
City:	State:	Zip:	Phone:

### Joint Venture Participants

Name:		Contact Person:	
Address:			
City	State:	Zip:	Phone:
% Ownership:	Certifying Entity:	Type Certification & Date: (S/M/W or DBE)	
Type of Work for which Certification was granted:			

Name:		Contact Person:	
Address:			
City	State:	Zip:	Phone:
% Ownership:	Certifying Entity:	Type Certification & Date: (S/M/W or DBE)	
Type of Work for which Certification was granted:			

### General Information

SBE/MBE/WBE/DBE Initial Capital Contributions: \$ _____ %	
Future capital contributions (explain requirements) (attach additional sheets if necessary):	
Source of Funds for the SBE/MBE/WBE/DBE Capital Contributions:	
Describe the portion of the work or elements of the business controlled by the SBE/MBE/WBE or DBE (attach additional sheets if necessary):	
Describe the portion of the work or elements of the business controlled by non-SBE/MBE/WBE or DBE: (attach additional sheets if necessary)	

## JOINT VENTURE ELIGIBILITY FORM

Describe the SBE/MBE/WBE or DBE's involvement in the overall management of the joint venture (e.g., participation on a management committee or managing board voting rights, etc.) (attach additional sheets if necessary)

Describe the SBE/MBE/WBE or DBE's share in the profits of the joint venture:

Describe the SBE/MBE/WBE or DBE's share in the risks of the joint venture:

Describe the roles and responsibilities of each joint venture participant with respect to managing the joint venture (use additional sheets if necessary):

a. SBE/MBE/WBE or DBE joint venture participant:

b. Non- SBE/MBE/WBE or DBE joint venture participant:

Describe the roles and responsibilities of each joint venture participant with respect to operation of the joint venture (use additional sheets if necessary):

a. SBE/MBE/WBE or DBE joint venture participant:

b. Non- SBE/MBE/WBE or DBE joint venture participant:

Which firm will be responsible for accounting functions relative to the joint venture's business?

Explain what authority each party will have to commit or obligate the other to insurance and bonding companies, financing institutions, suppliers, subcontractors, and/or other parties?

Please provide information relating to the approximate number of management, administrative, support and non-management employees that will be required to operate the business and indicate whether they will be employees of the SMWBE, non-SMWBE or joint venture:

	Non- SBE/MBE/WBE/DBE	SBE/MBE/WBE/DBE	Joint Venture
Management			
Administrative			
Support			
Hourly Employees			

## JOINT VENTURE ELIGIBILITY FORM

Please provide the name of the person who will be responsible for hiring employees for the joint venture.

Who will they be employed by?

Are any of the proposed joint venture employees currently employees of any of the joint venture partners?

Yes  
(Y)

No  
(N)

If yes, please list the number and positions and indicate which firm currently employs the individual(s), (use additional sheets if necessary)

Number of employees		Position	Employed By

Attached a copy of the proposed joint venture agreement, promissory note or loan agreement (if applicable), and any and all written agreements between the joint venture partners.

List all other business relationships between the joint venture participants, including other joint venture agreements in which the parties are jointly involved.


If there are any significant changes in or pertaining to this submittal, the joint venture members must immediately notify the Division of Small Business Opportunity.

COMP-FRM-015

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

<b>CONTRACT NO. CE00767 CHERRY CREEK TRANSFER STATION ADDITIONS</b>
---

▪ **ADDENDUM NO. 1 TO CONTRACT DOCUMENTS**

Bidders are hereby instructed that the drawings, specifications, and other contract documents are modified, corrected, supplemented and/or superseded for the above mentioned project as hereinafter described in the following attachments:

**BID FORM PACKAGE**

None

**BID DOCUMENT PACKAGE**

Notice is hereby given that Sealed Bids for Contract No. CE00767, CHERRY CREEK TRANSFER STATION ADDITIONS are hereby postponed. Sealed bids will be received at the OED Reception desk on the 2nd floor at 201 West Colfax, Denver, CO 80202 no later than: **11:00 a.m., Local Time**

**January 13, 2011**

**Conference Room 1.D.1**

Prior to submitting a bid, the bidder shall consult the Contractor's bulletin board, located on the 2nd floor at 201 W. Colfax Avenue, Denver, CO 80202; and Questcdn.com - eBid Document #1407381.

**SPECIFICATIONS**

**1.1 Section 03300 - Cast- In-Place Concrete**

- A. Page 7 and 8, Article 2.8 Curing Materials, delete Paragraphs "A. Evaporation Retarder" and "E. Waterborne Membrane-Forming Curing Compound" in their entirety. Curing shall be compatible with Floor Treatment specified in Article 2.7.

**1.2 Section 03450 - Precast Architectural Concrete**

- A. Page 9, Article 2.13 Finishes, delete Paragraph Headings A and B in their entirety and insert the following:

"A. Finish exposed-face surfaces of precast units to match Architect's approved sample and as follows

1. Exterior surface (form side) to be sand blasted to expose a light aggregate finish.
2. Interior finish to be steel troweled. Provide surfaces free of pockets, sand streaks, and honey comb, with uniform color and texture."

**1.3 Section 03450 - Precast Architectural Concrete**

- A. Page 9, Article 2.13, correct Paragraph Heading "2.13 Source Quality Control" to read "2.14 Source Quality Control."

**1.4 Section 08710 Hardware**

- A. Add attached Section 08710 to Project Specification. (See Attached 15 pages)

**1.5 Section 13125 Metal Building Systems**

- A. Page 5, Article 1.6 Quality Assurance, delete Paragraph B.1 AISC Certification in its entirety.

**1.6 Section 13125 Metal Building Systems**

- A. Page 6, Article 1.10 Warranty, delete Paragraph A.1 Siliconized Polyester Finish in its entirety.

**1.7 Section 13125 Metal Building Systems**

- A. Page 7, Article 1.10 Warranty, delete Paragraph Heading B, Paragraph 1, change to read: "1. Warranty Period: 20 years from date of Substantial Completion, Single Source 1."

**1.8 Section 13125 Metal Building Systems**

- A. Page 16, Article 2.11 Accessories, Paragraph Headings D. Flashing and Trim, E. Gutters, and F. Downspouts, change gauge of metal from "0.0159-inch" to "26 gauge".

**DRAWINGS**

**1.9 Sheet A11.1 Fleet Maintenance Building**

- A. Room Finish Schedule, Column "Floor", Change Floors noted as "Painted" to read "Treated". Floor and Slab Treatment is specified in "Section 03300 Cast-In-Place Concrete, Article 2.7".

**PRODUCTS ACCEPTED FOR BIDDING**

The following products are accepted for bidding, subject to all requirements of the Drawings and Specifications:

**Section 10155 Toilet Compartments**

Bradley

**Section 111126 - Vehicle Washing Equipment**

Westmatic

**QUESTIONS AND ANSWERS**

1. Hardware specification 08710 is not included with the bid package, please provide in addendum.

Response: Hardware Section 08710 will be included in Addendum No.1 to be issued on January 6, 2011.

2. Precast specifications, Section 2.13 Finishes, Part A,1, calls out Stresscon Cinnamon Mix ID SC501 as being the Design Reference Sample for the project. This type of precast product is fabricated per PCI MNL 116 tolerances and guidelines, because it is considered a structural product, even though it has integral color. However, the specifications require (pretty much throughout) that the precast be per PCI MNL 117 tolerances and guidelines (architectural products). MNL117 tolerances are much stricter than MNL 116 and will undoubtedly increase costs. Please advise how you would like to proceed.

Response: The Precast panels finishes have been changes in Addendum No.1.

3. Precast specifications, Section 2.13 Finishes, Part A,3 &4, call for finishes that do not match the finish used with the Stresscon Cinnamon CSB Product. This product has a light sandblasted finish. Also, there is no mention of "selected stones" cast into the panels in the drawings. Is this an error? Please advice.

Response: The Precast panels finishes have been changed in Addendum No.1.

4. Precast specifications, Section 2.13 Finishes, Part B, calls for finishing all sides of the panels to match the form-side face. The Stresscon Cinnamon CSB Product is fabricated with a face mix (cinnamon color) and a back-up mix (structural gray concrete). Using face mix for the entire product can be done at an increased cost, however, the sandblasted finish will not be identical to the form-side finish. Please advise how to proceed.

Response: The Precast panels finishes have been changed in Addendum No.1.

5. Sec. 15050,1.3, vs. Sec.13125,1.3,A & E - Braemar Buildings' standard standing seam metal roof is an Ultra-Dek, snap - lok system (saves seamer rental, labor, and materials). Will that be allowed (see profiles, attached)?

Response: Do not understand your paragraph references. Braemar Buildings is an approved product as specified in Section 13125, Article 2.1, Paragraph Heading C. and as such is permitted to use their standard details. We prefer the vertical standing seam as drawn, but if not available in the Braemar system then Ultra-Dek is acceptable.

6. Sec. 13125,1.5, B, 2 - "...projection of anchor bolts required..." PEMB provides the Anchor Bolt Plan, Templates, Frame Reactions, and diameter of the bolts, from the ground up. The Foundation Engineer provides the projection and type of anchor required, from the ground down. Still required by PEMB?

1.5, 5 - Accessory Drawings at a scale of not less than 1/2 inches per 12 inches. Those are standard details on 11" x 17" Detail blocks, not to scale. That would be the Architects scope of work. Still required?

Response: If your standard details are properly dimensioned but not drawn to scale, that is acceptable. If not, and all we have seen from Braemar are pictorial details, we want details at 1-1/2" scale of the Flashing and Trim, Gutters, and Downspouts as specified.

7. Sec. 13125,1.6, B - AISC Category MB has been defunct for over a year (see attached). Braemar Buildings is IAS AC 472 Certified in lieu of that. Will that be enforced?

Response: AISC certification will not be required now that AISC and MBMA have ended their certification program. See Addendum No.1.

8. Sec. 13125,1.10,1, all - Siliconized Polyester coatings conflicts with other Specifications and drawings but saves the owner about 10 cents per square foot. It has the same warranty as Kynar (see attached). Will it be allowed?

Response: No! Reference to Siliconized Polyester coating will be deleted from the Specification in Addendum No.1.

9. Sec. 13125, 1.10, B.1, Weathertightness Warranty -At what Type and reimbursement level (see attached)?

Response: We require 20 year, Single Source 1 Warranty. That will be clarified in Addendum No.1.

10. Sec.13125, 2.7, B, 1 - Loose clips for girts - Braemar Buildings makes an erector friendly building with the clips factory welded to the frames (saves labor, time frame for orienting clips in the field, weld inspections, and Certified Welder wages) Will that be allowed?

Response: If that is standard to the Braemar Buildings System, it is acceptable.

11. Sec. 13125, 2.11, D, 1 & 2, & F - Galvanized Steel thickness of 0.0159 is almost 30 ga. Braemar Buildings' standard Flashing, Gutters, and Downspouts is 24 or 26 ga. Will that be allowed?

Response: This will be clarified in Addendum No.1 as a standard 26 gauge.

12. Cross - Section Drawings say: "Standing Seam Metal Roof- R-19 Insulation over Metal Deck or Eq. Roof Panel System." Can we option an insulated roof panel (erectors say the labor savings will outweigh the material costs)?

Response: An insulated roof panel is acceptable provide it can clear span from purlin to purlin.

13. Sheet S2.2 - Can the hipped roof start and stop on framelines 4 and 2 (it needs some support to hold it up in the air)?

Response: No! The valleys are shown to matchup new and existing roof profiles, as well as gutter lines.

14. What is the exterior wall panel finish of the precast panels—Paintable Gray, Commercial Grade w/light sand blast, Architectural, etc.?

Response: Finish is Light Sand Blast. See Addendum No.1.

15. What is the thickness of the insulation in the precast panel? The thickest we can have in an 8" panel is 3".

Response: The thickness shown on the drawings is 3". The manufacturer can use the thickness his product needs to achieve an R-15 rating.

16. The specs call out for Extruded Polystyrene Insulation as opposed to Expanded Polystyrene Insulation. Extruded is about twice as expensive as Expanded, is expanded acceptable?

Response: No! Insulation shall be Extruded.

17. Shall all the exposed steel embed plates be galvanized?

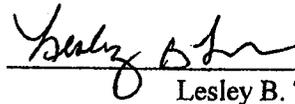
Response: If you are referring to the precast panels, the answer is yes.

18. Finish schedule calls for the floors to be painted, what material should be used? Did not see it in spec 09900Painting.

Response: The floors shall be finished with "Floor and Slab Treatment' as specified in "Section 03300 Cast-In-Place Concrete, Article 2.7". See Addendum No.1.

**End of Questions & Answers**

This **ADDENDUM** shall be attached to, become a part of, and be returned with the Bid Proposal.

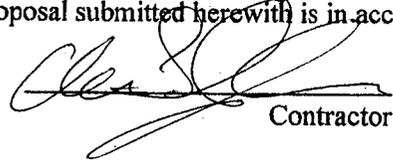


Lesley B. Thomas  
City Engineer

1.6.11

Date

The undersigned bidder acknowledges receipt of this Addendum. The Proposal submitted herewith is in accordance with the stipulations set forth herein.



Contractor

ADDENDUM NO. 1

DATE: 1/13/11

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

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**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**PROJECT NO. CE00767  
CHERRY CREEK TRANSFER STATION ADDITIONS**

**STATEMENT OF QUANTITIES**

<b>Item No.</b>	<b>Description</b>
Base Bid -	Fleet Maintenance Building Truck Wash Enclosure
Alternate No 1 -	Add Truck Wash Equipment
Alternate No 2 -	Not Used
Alternate No 3 -	Remodel Offices in Fleet Maintenance Building
Alternate No 4 -	Addition to Trash Transfer Building

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**NOTICE FOR INVITATION FOR BIDS  
FOR CONTRACT NO. CE00767**

**CHERRY CREEK TRANSFER STATION ADDITIONS**

**BID SCHEDULE:**

Sealed bids will be received at the Right-of-Way Counter on the 2<sup>nd</sup> floor at 201 West Colfax, Denver, CO 80202, no later than:

**11:00 AM, Local Time  
JANUARY 06, 2011**

Bids to be submitted more than thirty (30) minutes prior to the specified bid opening time shall be presented at the Office of Contract Administration, Attention: Public Works Contract Administration, 201 West Colfax Avenue, Department 614, Denver, Colorado 80202. All properly delivered bids will then be publicly opened and read aloud in Room I.D.1 on the 1st floor at 201 West Colfax Avenue, Denver, Colorado 80202:

Prior to submitting a bid, the bidder shall consult the Contractor's Bulletin Board located at 201 W. Colfax, 2<sup>nd</sup> Floor, Denver, Colorado, 80202 and/or [www.work4denver.com](http://www.work4denver.com).

**GENERAL STATEMENT OF WORK:**

Addition of a truck wash enclosure to the existing fleet maintenance building and alternates including; truck wash equipment, interior office remodeling and expansion of the existing trash transfer building..

**ESTIMATED CONSTRUCTION COST:**

The estimated cost of construction for this project is between \$700,000.00 and \$760,000.00.

**DOCUMENTS AND BID INFORMATION AVAILABLE:**

Contract Documents complete with Technical Specifications and, if applicable, construction drawings will be available on the first day of publication at: [www.work4denver.com](http://www.work4denver.com) to download digital Contract Documents at a cost of \$10.00 per download (eBid Document Number #1407381). Contact QuestCDN.com at 952-233-1632 or [info@questcdn.com](mailto:info@questcdn.com) for assistance.

**PRE-BID CONFERENCE:**

A pre-bid conference will be held for this Project at 10:30 AM, local time, on DECEMBER 15, 2010. This meeting will take place at the Cherry Creek Transfer Station, 7301 East Jewel Ave. (NE corner of Quebec Ave.), Denver, CO.

**DEADLINE TO SUBMIT QUESTIONS:** December 28, 2010 @ 3:00PM local time.

**PREQUALIFICATION REQUIREMENTS:**

Each bidder must be prequalified as a 7a General in the \$1,500,000.00 monetary level in accordance with the City's Rules and Regulations Governing Prequalification of Contractors. Each bidder must have submitted a prequalification application a minimum of ten (10) calendar days prior to the bid opening date. Applications must be submitted to the Department of Public Works, Prequalification Section, 201 West Colfax Avenue, Department 506, Denver, Colorado 80202. To view the Rules and Regulations and to obtain a prequalification application, please visit our website at [www.denvergov.org/prequalification](http://www.denvergov.org/prequalification) or call 720-865-2539 for prequalification information ONLY.

**MINORITY AND WOMAN BUSINESS ENTERPRISE PARTICIPATION:**

Construction, reconstruction and remodeling contracts made and entered into by the City and County of Denver are subject to Article III, Divisions 1 and 3 of Chapter 28 of the Denver Revised Municipal Code, (Sections 28-31 to 29-

36 and 28-52 to 28-90 D.R.M.C) and all Minority and Woman Business Enterprise and Equal Employment Opportunity Rules and Regulations adopted by the Director of the Division of Small Business Opportunity.

Article III, Division 3 of Chapter 28 of the D.R.M.C. directs the Director of the Division of Small Business Opportunity to establish a project goal for expenditures on construction, reconstruction, and remodeling work contracted by the City and County of Denver. The specific goal for this project is:

**19% Minority and Woman Business Enterprise (M/WBE) Participation**

Project goals must be met with certified participants as set forth in Section 28-60, D.R.M.C. or through the demonstration of a sufficient good faith effort under Section 28-62 D.R.M.C. For compliance with good faith requirements under Section 28-62(b), **the M/WBE percentage solicitation level required for this project is 100%.**

The Director of the Division of Small Business Opportunity urges all participants in City construction, reconstruction and remodeling projects to assist in achieving these goals.

**MISCELLANEOUS:**

Contracts for construction, reconstruction, and remodeling are subject to the City prevailing wage rate requirements established pursuant to Section 20-76, D.R.M.C.

As its best interest may appear, the City and County of Denver reserves the right to reject any or all bids and to waive informalities in bids.

If applicable, a shortened version of this Notice of Invitation for Bids and the Statement of Quantities can be viewed on the City and County of Denver website at:

<http://www.denvergov.org/SearchBidAdvertisements/tabid/385460/Default.aspx>.

Publication Dates: December 7, 8, 9, 2010  
Published In: The Daily Journal

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**INSTRUCTIONS TO BIDDERS**

**IB-1 INSTRUCTION TO BIDDERS**

These Instructions to Bidders are a part of the Contract Documents and are intended to serve as a guide to bidders. They are general in nature and may be amended or supplemented as needed to support any one specific invitation to bid. Each bidder shall prepare its bid in strict compliance with all requirements of the Contract Documents and by careful application of these instructions.

**IB-2 BIDDING**

The copy of the Contract Documents contains the Bid Form and Submittal Package for this Project, which must be used to submit a bid hereunder. The bidder must fully complete, execute and submit this Bid Form and Submittal Package, along with any other specified components of the Contract Documents, as its bid for the referenced Project.

A bidder is not required to submit as part of its bid the entire set of Contract Documents distributed by the City pursuant to the Notice of Invitation for Bids, if the bidder executes and submits the Bidder Acknowledgment Form included with the Bid Form and Submittal Package as part of its bid. However, each bidder, by submitting its bid, shall be conclusively presumed to have received and reviewed all of the information contained in the Contract Documents as this term is further defined herein.

Each bid must be enclosed in a sealed envelope, must be addressed to the Manager and must show on the face of the envelope the full name of the bidder, the City Project number, and descriptive title of the Project for which the bid is made.

The advertisement for Notice of Invitation for Bids will identify where and when the bid must be delivered.

**IB-3 CONTRACT DOCUMENTS AS PUBLISHED BY CITY**

Each bidder shall be responsible for, and shall be deemed to have received, all the information contained in the Contract Documents as distributed by the City pursuant to the Notice of Invitation for Bids, including addenda, whether or not such bidder has reviewed all or part of the Contract Documents in either its hard copy form or in any other format. If organizations or companies other than the City or its design professional distribute the City's Contract Documents for review by prospective bidders, whether in hard copy or via electronic or other media, neither the City nor its design professional shall be responsible for the content, completeness or accuracy of any information distributed or transmitted by any such organization or company.

**IB-4 COMPLETING AND SIGNING THE BID FORMS**

The bidder must complete the Bid Form by legibly writing or printing in ink, in words and figures as required, all the bidder's prices offered for the Work to be performed. All blank spaces, which require a response of the bidder, must be properly completed in full. If in the process of evaluating a bid, words and figures, as written on the Bid Form by the bidder, do not agree, the written words will govern.

For Bid Forms requiring unit price bids, the bidder shall write in the Bid Form spaces provided a unit price for each item for which a quantity is given and shall also write the product of each unit price and the quantity specified in the "Amount" or "Total" space provided.

Each bidder must sign the Bid Form and give the bidder's current business address. If an individual, the signature must be of the individual offering the bid; if a partnership, the signature must be that of a general partner; and if a corporation, both the president and the secretary must sign and the seal of the corporation must be affixed. Signatures of other persons may be acceptable if the bid contains sufficient evidence, satisfactory to the City in its sole discretion, to indicate that the other persons are authorized to bind the bidder.

**IB-5 UNACCEPTABLE BIDS**

The City will not accept bids from Bidders not prequalified with the Department of Public Works (if prequalification is required for this project), in arrears to the City upon debt or contract, or which are defaulters (as surety or otherwise) upon any obligation to the City.

**IB-6 INFORMAL AND UNBALANCED BIDS**

Any alteration, interlineations, erasure, omission, deletion or addition by the bidder to the Bid Form and Submittal Package or other parts of the Contract Documents submitted with the Bid Form and Submittal Package, as originally issued to the bidder, shall render the accompanying bid informal and may constitute cause for rejection.

Any unauthorized addition, conditional or alternate bids, failure to provide a unit price, lump sum amount or authorized alternate item specified or other irregularities of any kind which tend to render the bid incomplete, indefinite or ambiguous shall render the bid informal and may constitute cause for rejection.

Bids that are unbalanced so that each item does not reasonably carry its own proportion of cost or that contain inadequate or unreasonable prices for any item may be rejected. Bids, which have not acknowledged all addenda to the Contract Documents issued for this bid, may also be rejected.

The right is reserved by the City to reject any or all bids and to waive any informalities where it is deemed by the City to be in the best interests of the City to do so.

**IB-7 ONLY ONE BID ACCEPTED**

The City will accept only one bid for the same work from any one bidder. This includes bids that may be submitted under different names by one business enterprise.

**IB-8 BID GUARANTEE**

As a guarantee of good faith on the part of the bidder, each bid must be accompanied by a bid 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 bid bond written by an approved corporate surety in favor of the City and County of Denver. If the bid of a bidder is acceptable and the bidder is notified by the Manager that it is considered to be the Apparent Low Bidder and said bidder fails to execute a contract in the form prescribed or to furnish a performance and payment bond with a legally responsible and approved surety or to furnish the required evidence of insurance or satisfy all conditions precedent to contract execution within five (5) days after such notice is made by the City, said bid guarantee shall be forfeited to the City as liquidated damages and not as a penalty.

The bid guarantee shall be in the amount of five percent (5%) of the total bid unless otherwise specified in the Notice of Invitation for Bids and on the form appearing in the Contract Documents in the Bid Form and Submittal Package. Failure to submit a proper bid guarantee, satisfying all of the requirements specified herein and on the form provided herein shall render the bid nonresponsive and may constitute cause for rejection.

Following award and execution of the Contract by the Apparent Low Bidder, or earlier in the sole discretion of the City, bid guarantees of all but the Apparent Low Bidder will be returned. When the Apparent Low Bidder executes the Contract and delivers to the City satisfactory performance and payment bonds, required insurance documentation, and has satisfied all conditions precedent to contract execution by the City, and after approval, if any, by the Council of the City of the proposed Contract with the Apparent Low Bidder, the bid guarantee of the Apparent Low Bidder shall be returned. Such return shall be made within one hundred twenty (120) days from date bids are opened unless otherwise specified in the Special Contract Conditions.

**IB-9 SITE INSPECTION AND INVESTIGATIONS**

Prior to submitting a bid, the bidder is invited to inspect the work site and its surroundings. Although the bidder is not required to make such an inspection before bidding, for purposes of the Contract it shall be conclusively presumed that by failing to make such an inspection, the bidder has waived the right to later claim additional compensation or time extensions for conditions which would have been evident had the site been inspected.

Drawings and Technical Specifications, defining the Work to be done, were prepared on the basis of interpretation by the design professionals of information derived from investigations of the work site. 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 bidder is invited to make such additional investigations as the bidder's judgment dictates the need for such investigations. Information about the degree of difficulty of the Work to be done cannot totally be derived from either the Drawings or Technical Specifications or from the Manager or his representatives.

Since the bid information cannot be guaranteed, the Contractor shall have assumed the risks attendant to successful performance of the Work and shall never make claim for additional compensation or time extensions on the grounds that the nature or amount of work to be done was not understood by the bidder at the time of the bidding.

**IB-10 INCONSISTENCIES**

Any seeming inconsistencies or ambiguities between different provisions of the Contract Documents or any point which the bidder believes requires a decision or interpretation by the City must be inquired into by the bidder by addressing a formal written communication to the Manager of Public Works and sending or delivering it to the offices of the Division of Public Works advertising this Project for bid at least forty-eight (48) hours, excluding Saturdays, Sundays, and holidays, before the time set for the opening of bids

Information about the decision or interpretation made in response to any inquiry will be posted on the Contractor's Bulletin Board (refer to IB-12 CONTRACTOR'S BULLETIN BOARD, for the location of the Contractor's Bulletin Board). If the matter raised requires, in the sole discretion of the Manager, that an addendum to the bid documents be issued, such addendum will be published and each bidder shall be required to acknowledge the addendum by signing and identifying it in the Bid Form when submitting the bid.

After bids are opened, all bidders must abide by the formal response of the Manager, as to any interpretation. The City shall not be bound and the bidder shall not rely on any oral communication, interpretation clarification or determination of the Contract Documents prior to bid opening.

**IB-11 WITHDRAWAL OF BID**

A bidder may withdraw its bid at any time prior to the time for receipt of bids set forth in the Notice of Invitation for Bids by making written request upon the Manager of Public Works. After such time, no bid may be withdrawn or modified.

Such request must be signed by the persons authorized to bind the bidder as defined in IB-3, COMPLETING AND SIGNING BID FORMS.

**IB-12 CONTRACTOR'S BULLETIN BOARD**

It shall be conclusively presumed that the bidder has, before submitting any bid, read and shall take full responsibility for all addenda, posted decisions, and other information relevant to the bid posted by the City on the Contractor's Bulletin Board. The Contractor's Bulletin Board is located at 201 W. Colfax, 2<sup>nd</sup> Floor, Denver, CO 80202, in the Wellington E. Webb Municipal Office Building.

**IB-13 PRE-BID MEETING**

Bidders are urged to attend the pre-bid meeting(s) scheduled for this Project. Attendance is not mandatory; however, bidders will be held responsible for all information presented at such meeting(s).

**IB-14 ADDENDA**

As its best interests may require, the City may issue addenda to the Contract Documents. Such addenda shall be posted on the Contractor's Bulletin Board and made available to all persons having purchased a set of Contract Documents as set forth in the Notice of Invitation for Bids contained herein. All bidders must acknowledge receipt of all addenda on the Bid Form at the time of submission of the bid.

**IB-15 BID OPENING**

Bidders are invited to be present at the bid opening. Unless otherwise suspended, delayed or canceled by posted notice from the Manager, bid opening will occur at the time and place designated in the Notice of Invitation for Bid.

**IB-16 EVALUATION OF BIDS AND BASIS OF BID SELECTION**

Bids will be evaluated after being read in open meeting at the place designated for such bid opening. All low bidders' bids will be reviewed for responsiveness to the requirements of the Contract Documents and whether or not the bids contain irregularities which could give any bidder an unfair advantage.

Selection will be made on the basis of the lowest, total, responsive, qualified bid, which bid shall include the total base bid set forth on the Bid Form, plus the total of any alternates set forth on the Bid Form and selected by the City during evaluation. Alternates, if any are included in the bid, will be selected in the priority shown on the Bid Form, subject to the limits of available funds. Bid selection will be subject to all requirements and special bidder qualifications contained herein and subject to approval of such resulting Contract in accordance with the Charter and Revised Municipal Code of the City and County of Denver. In addition to all other specified requirements, the City will correct arithmetical errors in all bids and corrected totals only will be considered as the basis of selection.

Upon concluding that the bid is, in fact, the lowest, total, responsive bid to the bidding conditions and that of a responsible, qualified bidder, the City will notify the Apparent Low Bidder.

As its best interests may appear, the City and County of Denver reserves the right to waive informalities in bids, to reject any and all bids and to rebid the Project.

**IB-17 NOTICE TO APPARENT LOW BIDDER**

The Notice to Apparent Low Bidder, a form of which is included in the Contract Special Conditions Section of the Contract Documents, is issued by the City directly to the selected bidder and informs the bidder that the Manager intends to seek approval of the execution of the Contract by the City in accordance with the Charter and Revised Municipal Code of the City and County of Denver. Specifically, it informs the bidder of its obligations with respect to execution of the Contract and instructs the bidder on how to proceed toward execution of the Contract. The City reserves the right to notify the Apparent Low Bidder, at any time within one hundred twenty (120) days from the date of the opening of the bids, that approval to contract with the Apparent Low Bidder shall be sought in accordance with the Charter and Revised Municipal Code of the City and County of Denver.

In accordance with the terms and conditions contained in the Bid Form and Submittal Package and any additional requirements set forth in the Notice to Apparent Low Bidder or elsewhere in the Contract Documents, the Apparent Low Bidder shall execute the Contract Form contained in the bound sets of Contract Documents made available by the City for execution in the appropriate number of counterparts. The Apparent Low Bidder shall return the fully executed Contract Document sets, along with any supplemental documents required herein, to the City and shall comply with all other conditions precedent to Contract execution within five (5) days of the date of issuance of the Notice to Apparent Low Bidder by the City. Failure to comply with each of these requirements within five (5) days of the date of issuance of the Notice to Apparent Low Bidder by the City shall render the bid nonresponsive and may constitute cause for rejection.

Issuance of such Notice shall not, however, constitute a commitment on the part of the City or create any rights in the Apparent Low Bidder to any contract with the City.

**IB-18 EXECUTION OF CONTRACT**

The process of executing a contract requires action by both the apparent low bidder and the City. After it notifies the Apparent Low Bidder, the City will prepare sufficient copies of the Contract Documents by incorporating all of the documents submitted by the Apparent Low Bidder into executable copies of the Contract Documents made available pursuant to the Notice of Invitation for Bids. These copies will then be made available to the Apparent Low Bidder who shall thereafter properly sign all of the copies. At this time, the successful bidder shall also provide certain supplemental documents for incorporation into the Contract Documents. These supplemental documents shall include: the properly executed Certificate of

Insurance Forms evidencing the apparent low bidder's satisfactory compliance with the insurance requirements set forth in the Contract Documents; a properly executed Payment and Performance Bond Form and appropriate Power of Attorney evidencing the Apparent Low Bidder's satisfactory compliance with the bonding requirements set forth in the Contract Documents; and documentation of compliance with any other conditions precedent to execution of the Contract by the City set forth in the Contract Documents. The insurance and bond forms contained in the Contract Special Conditions Section of the Contract Documents must be used in satisfying these supplemental document requirements.

These documents are then delivered to the City within the prescribed time period for examination of the documents to determine whether or not the Contractor has correctly executed the Contract and has correctly provided the required supplemental documents and that these documents are satisfactorily and properly completed. From here, all of the documents are forwarded to the City Attorney who will, if the insurance and bonding offered is acceptable and if all other elements of the Contract Documents are in order, recommend that the Manager and the Mayor approve the documents and, when required by the City Charter, prepare an ordinance for submittal to City Council authorizing the execution of the Contract. The City Attorney shall in all applicable instances submit the proposed contract and ordinance to City Council. After City Council approval, the Contract shall be reviewed by the City Attorney and routed for execution by the Mayor, the Clerk for attestation and the Auditor for countersignature and registration. When the total process of contract execution is complete, a Notice to Proceed will be issued and a single executed copy of the Contract will be delivered to the Contractor. Any work performed or materials purchased prior to the issuance of Notice to Proceed is at the Contractor's risk.

#### **IB-19 BONDING REQUIREMENTS**

In accordance with the provisions of General Contract Conditions, Title 15, PERFORMANCE AND PAYMENT BONDS, the minimum bonding requirements for this Contract are set forth in the form **CITY AND COUNTY OF DENVER PERFORMANCE AND PAYMENT BOND** contained in the Special Conditions Section of the Contract Documents. Upon receipt of Notice to Apparent Low Bidder, the apparent low bidder must cause this form bond to be purchased, executed and furnished, along with appropriate Powers of Attorney and a surety authorization letter (in form similar to the one attached), to the City in accordance with the instructions contained herein.

#### **IB-20 INSURANCE REQUIREMENTS**

The minimum insurance requirements for this Contract are set forth in the Special Conditions Section of the Contract Documents. Bidders are urged to consider, in preparing a bid hereunder, that each condition, requirement or specification set forth in the form certificate must be complied with by the Contractor and all subcontractors performing Work on the Project, unless such requirements are specifically accepted in writing by the City's Risk Management Office. The Contractor must either include all subcontractors performing work hereunder as insureds under each required policy or furnish a separate certificate for each subcontractor. In either case, the Contractor shall insure that each subcontractor complies with all of the coverage requirements.

#### **IB-21 PERMITS AND LICENSES**

All permits, licenses and approvals required in the prosecution of the work shall be obtained and paid for by the Contractor.

#### **IB-22 WAGE RATE REQUIREMENTS**

In preparing any bid hereunder, the Contractor must comply with and should carefully consider all requirements and conditions of the City's Payment of Prevailing Wages Ordinance, Sections 20-76 through 20-79, D.R.M.C. and any determinations made by the City pursuant thereto.

At the time of the preparation of the Contract Documents, the then-current prevailing wage rates applicable to this Project shall be bound within the Contract Documents made available to potential bidders for the Project. If, more than ten (10) days prior to the actual date of bid opening, the Career Service Board determines that prevailing wages rates different from those bound in the Contract Documents are applicable to one or more of the various classes of laborers, mechanics and workers encompassed by this Project, such different prevailing wage rates shall be provided in an addendum. If different prevailing wage rates are determined by the Career Service Board ten (10) or less days prior to the actual date of bid opening, the City will determine on a case by case basis in its sole discretion whether such different prevailing wage

rates are to be included in an addendum. In conjunction with such determination, the City may elect, in its sole discretion, to postpone the date of bid opening on the Project. In any event, the bidder will be held, at the actual date of bid opening, to those prevailing wage rates incorporated into the Contract Documents and as modified by any such addenda.

These prevailing wage rates shall be considered the **minimum** City prevailing wage rates to be paid by all contractors or subcontractors for a period not to exceed one (1) year from the date of the Contract. Increases in prevailing wages subsequent to the date of the Contract for a period not to exceed one (1) year shall not be mandatory on either the contractor or subcontractors. Future increases in prevailing wages on contracts whose period of performance exceeds one (1) year shall be mandatory for the contractor and subcontractors only on the yearly anniversary date of the Contract. The **minimum** City prevailing wage rate for any such 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 over the amounts thereof as stated in such Technical Specifications and addenda thereto 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 any such contract with the City. Decreases in prevailing wages subsequent to the date of the contract for a period not to exceed one year (1) shall not be permitted. Decreases in prevailing wages on contracts whose period of performance exceeds one (1) year shall not be effective except on the yearly anniversary date of the contract.

#### **IB-23 TAX REQUIREMENTS**

General. Bidders are referred to the General Contract Condition 322, TAXES, 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 Contract Conditions and not in lieu of them.

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 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.

It is the 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. Bidders shall not include in their bid amounts the exempt state, RTD, and Cultural Facilities District Sales and Use Taxes.

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-24 DISCLOSURE OF PRINCIPALS**

Pursuant to D.R.M.C. 20-69, any bid in excess of \$100,000.00 must be accompanied by a separate detachable page setting forth the following information:

(1) The name of any officer, director, owner or principal of the business entity, including identity of any shareholder who owns or controls 5% or more of the business entity, and either 1) the names of his or her spouse, and children under eighteen years of age; or 2) a statement that he or she or his or her spouse, or children, if any, under the age of eighteen have or have not made a contribution, as defined in D.R.M.C. 15-32, or contribution in kind, as defined in D.R.M.C. 15-32, to any candidate, as defined in D.R.M.C. 15-32, during the last five years and identifying by name himself or herself or any spouse or child under the age of eighteen who has made such a contribution or contribution in-kind to a candidate.

(2) The names of any subcontractors or suppliers whose share of the bid exceeds \$100,000.00 of the contract or formal bid amount.

(3) The names of any unions with which the bidder has a collective bargaining agreement.

**If the total bid amount is in excess of \$500,000.00, the information required in (1) above must be provided at the time of bid submittal**, and the information required in (2) and (3) must be submitted in a timely fashion prior to award. The list of subcontractors required by this instrument is different and separate from the bidding list required on BF-4.

**If the total bid amount is less than \$500,000.00 but more than \$100,000.00, such information must be provided prior to award of the contract**. Failure to provide the required information in a timely fashion shall render any bid to which D.R.M.C. 20-69 applies non-responsive.

While a bidder or supplier who has already disclosed such information need not provide such information with a second or subsequent bid or proposal unless such information has changed, it shall be the responsibility of each such bidder or proposer to verify that such information is still current as of the date of such subsequent bid or proposal and is in fact on file with the City Clerk.

A form, which may be used for such disclosure, is contained in the Special Conditions Section of the Contract Documents. The form is entitled: Bidder/Contractor/Vendor/Proposer Disclosure. Failure to provide or update the required information in a timely fashion shall render any bid to which D.R.M.C. 20-69 applies non-responsive.

#### **IB-25 MINORITY AND WOMAN BUSINESS ENTERPRISE (M/WBE) REQUIREMENTS**

Article III, Divisions 1 and 3 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 these Bid Documents as the “M/WBE Ordinance” and any Rules or Regulations promulgated pursuant thereto apply to this Project and are incorporated into these Bid Documents by reference. Generally, the M/WBE 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 and Woman Business Enterprises (M/WBEs). As such, each bidder must comply with the terms and conditions of the M/WBE Ordinance in making its bid and, if awarded the Contract, in performing all Work thereunder. A bidder’s failure to comply with the M/WBE 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 M/WBE Ordinance requirements during the performance of the contract is a material breach of the contract, which may result in the in the imposition of sanctions on the Contractor, as deemed appropriate by DSBO. Copies of the M/WBE 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 M/WBE 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 M/WBE Ordinance.

### Meeting Established Goal

In preparing a bid to meet the established Project goal, bidders should consider the following instructions relating to compliance with the M/WBE Ordinance:

1. Under the M/WBE 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 and Woman 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 M/WBE of any tier which the bidder intends to use in performing the work on this Project. **Only the M/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.** M/WBE bidders may count self-performance or joint venture activity in meeting the M/WBE project goal, but only for the scope of work performed as a commercially useful function and at a percentage level the M/WBE will be performing itself.

If a bidder/proposer is participating in a joint venture with a certified M/WBE firm, complete the Joint Venture Eligibility form and Joint Venture Affidavit contained in this bid document/RFP. Submit the aforementioned forms with the firm's Joint Venture Agreement, to the DSBO Director, **at least 5 working days prior to the proposal submittal.** The Joint Venture must be approved prior to the bid opening or proposal submittal by the DSBO Director. Approval by the DSBO Director includes determining the amount the Joint Venture will count towards meeting the project goal.

3. All M/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 M/WBE Construction omit construction Directory ("Directory"), which is a current listing of M/WBEs that have been certified by the City. A copy of the DSBO Directory is located at DSBO web site at [www.milehigh.com/business/do-business](http://www.milehigh.com/business/do-business). Bidders are encouraged to use the Directory to assist in locating M/WBEs for the work and supplies required on the Project. Bidders are reminded that changes may be made to the Directory at anytime in accordance with the City's M/WBE Ordinance and procedures established to administer this program and a current copy of the Directory must always be used in preparing a bid. M/WBE certification or listing in the Directory is not a representation or warranty by the City as to the qualifications of any listed M/WBE.
4. In accordance with the provisions of the M/WBE Ordinance, DSBO will evaluate each bid to determine the responsiveness of the bid to the requirements of the M/WBE Ordinance. In determining whether a bidder's committed level of participation meets or exceeds the stated M/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 M/WBE percentage established for the project to determine the exact dollar amount of required M/WBE participation for the Project. This amount will then be compared against the exact dollar amounts for the M/WBE committed for participation by the bidder. If the total dollar amount of participation listed meets or exceeds the established M/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 M/WBE by dividing the dollar amount listed for each M/WBE by the total base bid dollar

amount submitted by the bidder. These individual percentages, when totaled for all listed M/WBE, will establish the total committed percentage level of M/WBE participation that the bidder must comply with during the life of the contract. In all cases, the committed percentage level of M/WBE participation must equal or exceed the assigned M/WBE goal for the Project.

- c. In providing the exact dollar amount of participation for each listed M/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 M/WBE goal.
  - d. As previously mentioned, compliance with the M/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 M/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 M/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 M/WBE goal on the remaining reduced amount.
  - f. On bids which, at the time of bid opening, are equal to or exceed Five Million Dollars (\$5,000,000.00), including any alternates which may be selected, only sixty percent (60%) of the value of the commercially useful function performed by M/WBE suppliers shall count toward satisfaction of the Project goal. On Projects under Five Million (\$5,000,000.00) the value of the commercially useful function of M/WBE supplier(s) will count at a one hundred percent (100%) level. Manufacturer's representatives and packagers shall be counted in the same manner as brokers.
  - g. In utilizing the M/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 "M/WBE Letter of Intent" for each M/WBE listed on the Bid Form as a joint venture member, subcontractor, supplier, manufacturer, manufacturers' representative or broker of any tier. An M/WBE Bidder needs to submit a Letter of Intent for themselves, and must identify their level of participation on the designated M/WBE participation page bound herein. A Letter of Intent shall be submitted only for the M/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 M/WBE Letter of Intent is included with the Bid Form. The M/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 M/WBE or that its subcontractor(s) and supplier(s), manufacturer(s), manufacturers' representative(s) and broker(s) will do so. Each M/WBE Letter of Intent shall be accompanied by a copy of the City and County of Denver's M/WBE certification letter for each proposed M/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.

**Good Faith Effort.**

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

1. If the bidder or proposer has not fully met the project goal as provided in section 28-60, then it shall demonstrate that it has made good faith efforts to meet such goal. The bidder or proposer shall furnish to the director, within three (3) working days after bid opening by the City or on or before the time of the final project-specific proposal submitted to and authorized by the City pursuant to a competitive selection process, or bid selection by a private owner, a detailed statement of its good faith efforts to meet the project goal set by the director. This statement shall address each of the items in subsection (b) and any additional criteria that the director may establish by rule or regulation consistent with the purposes of this division 3. Good faith efforts must be demonstrated to be meaningful and not merely for formalistic compliance with this division 3. The scope and intensity of the efforts will be considered in determining whether the bidder or proposer has achieved a good faith effort.
2. 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:
  - a. 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.
  - b. 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.
  - c. 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.
  - d. 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.

- e. 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.
  - f. 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.
  - g. 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.
  - h. 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.
  - i. 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.
  - j. The bidder or proposer must use the DSBO MBE/WBE directories to identify, recruit, and place MBEs and WBEs.
3. In determining whether a bidder or proposer has satisfied good faith efforts as to a project goal, the success or failure of other bidders or proposers on the contract in meeting such project goal may be considered.

#### **Continuing Commitments.**

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

1. The bidder understands it must maintain M/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, which will allow the City to assess progress in achieving the M/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 M/WBE 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 M/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 M/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 M/WBEs in accordance with Section 28-73 of the M/WBE Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-75(c) of the M/WBE Ordinance. The contractor shall supply to the director the documentation described in Section 28-75(c) of the M/WBE 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 M/WBE 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 M/WBE 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 M/WBE Ordinance or contact the Project's designated DSBO representative at (720) 913-1999.

#### **IB- 26 DISCLOSURE OF INFORMATION**

All submissions and other materials provided or produced pursuant to this Invitation for Bids may be subject to the Colorado Open Records Law, C.R.S. 24-72-201, et seq. As such, bidders are urged to review these disclosure requirements and any exceptions to disclosure of information furnished by another party and, prior to submission of a bid to the City, appropriately identify materials that are not subject to disclosure. In the event of a request to the City for disclosure of such information, the City shall advise the bidder of such request to give the bidder an opportunity to object to the disclosure of designated confidential materials furnished to the City. In the event of the filing of a lawsuit to compel such disclosure, the City will tender all such material to the court for judicial determination of the issue of disclosure and each bidder agrees to intervene in such lawsuit to protect and assert its claims of privilege against disclosure of such material. Each bidder further agrees to defend, indemnify and save and hold harmless the City, its officers, agents and employees, from any claim, damages, expense, loss or costs arising out of the bidder's intervention to protect and assert its claims of privilege against disclosure under the Open Records Law including, but not limited to, prompt reimbursement to the City of all reasonable attorney fees, costs and damages that the City may incur directly or may be ordered to pay by such court.

#### **IB-27 GENERAL BIDDING INFORMATION**

Bidders are instructed to contact the Contract Administrator designated below for this Project for pre-bid, post-bid and general City bidding information. Bidders can also visit [DenverGov.com](http://DenverGov.com) for information, both general and project specific. The Contract Administrator assigned to this project is Jo Ann Phillips, who can be reached via email at [joann.phillips@denvergov.org](mailto:joann.phillips@denvergov.org).

**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 subject 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 Division of Small Business Opportunity.
- 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 III, 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. "Division of Small Business Opportunity" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

**RULE II - 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 (10) 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 Division of Small Business Opportunity 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 the 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 Division of Small Business Opportunity shall perform the duties assigned to such official by Article III, Division 2 Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Division of Small Business Opportunity 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 Division of Small Business Opportunity; 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 Division of Small Business Opportunity 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 Division of Small Business Opportunity 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 the Notice to Proceed, a sign-off will be required of the Director of the Division of Small Business Opportunity 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 and 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 Denver Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen (15) 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.

**CITY AND COUNTY OF DENVER**  
**DEPARTMENT OF PUBLIC WORKS**

**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 of Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and the Director.
5. The Contractor will furnish all information and reports required by Article III, Division 2 of 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 canceled, 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 of 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 on each subcontractor or supplier. 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 of 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.

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**APPENDIX F**

**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.

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Manager of Public Works  
City and County of Denver

**A. REQUIREMENTS - AN AFFIRMATIVE 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 Division of Small Business Opportunity (DSBO). 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 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	GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE
From January 1, 1982 to Until Further Notice	From January 1, 1982 to Until Further Notice
<b>21.7% - 23.5%</b>	<b>6.9%</b>

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.

\* "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian Americans, and American Indians, and includes both men and minority women.

**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 the Division of Small Business Opportunity 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 Division of Small Business Opportunity 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.

**B. 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 of 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 III, Division 2 of 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 III, Division 2 of Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Division of Small Business Opportunity shall review the Contractor's employment practices during the performance of the contract. If the Division of Small Business Opportunity determines that the Contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

**C. 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 of 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.

**D. 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 III, 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 III, 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, 201 W. Colfax, Dept. 608, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**CONTRACT NO. 201100583 (Formerly CE00767)**

**CHERRY CREEK TRANSFER STATION ADDITIONS**

**CONTRACT**

**THIS CONTRACT AND AGREEMENT**, made and entered into by and between the City and County of Denver, a municipal corporation of the State of Colorado, hereinafter referred to as the "City," party of the first part, and ,

**Ash & White Construction  
dba White Construction Group. LTD  
18 S. Wilcox St., Suite 100  
Castle Rock, CO 80104**

hereinafter referred to as the "Contractor," party of the second part,

**WITNESSETH**, Commencing on **December 7, 2010**, and for at least three (3) days the City advertised that sealed bids would be received for furnishing all labor, tools, supplies, equipment, materials, and everything necessary and required for the following:

<p><b>CONTRACT NO. 201100583 (Formerly CE00767)</b> <b>CHERRY CREEK TRANSFER STATION ADDITIONS</b></p>
--

**WHEREAS**, bids pursuant to said advertisement have been received by the Manager of Public Works, who has recommended that a Contract for said work be made and entered into with the above named Contractor who was the lowest, responsive, qualified bidder therefore, and

**WHEREAS**, said Contractor is now willing and able to perform all of said work in accordance with said advertisement and its bid.

**NOW THEREFORE**, 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:

**1. CONTRACT DOCUMENTS**

It is agreed by the parties hereto that the following list of documents, instruments, technical specifications, plans, drawings and other materials which are attached hereto and bound herewith, incorporated herein by reference or otherwise referenced in these documents constitute and shall be referred to either as the "Contract Documents" or the "Contract," and all of said documents, instruments, technical specifications, Plans, Drawings and other materials 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:

*Advertisement of Notice of Invitation for Bids  
Instructions to Bidders  
Commitment to M/WBE Participation  
Article III, Divisions 1, 2, and 3 of Chapter 28, D.R.M.C.  
Bid Bond  
Addenda (as applicable)*

*Equal Employment Opportunity Provisions (Appendix A and Appendix F)*  
*Bid Form*  
*Contract Form*  
*General Contract Conditions*  
*Special Contract Conditions*  
*Performance and Payment Bond*  
*Notice to Apparent Low Bidder*  
*Notice to Proceed*  
*Contractor's Certification of Payment Form*  
*Final/Partial Lien Release Form*  
*Certificate of Contract Release*  
*Change Orders (as applicable)*  
*Federal Requirements (as applicable)*  
*Prevailing Wage Rate Schedule(s)*  
*Technical Specifications*  
*Contract Drawings*  
*Accepted Shop Drawings*

**2. SCOPE OF WORK**

The Contractor agrees to and shall furnish all labor, tools, supplies, equipment, 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.

**3. TERMS OF PERFORMANCE**

The Contractor agrees to undertake the performance of the Work under this Contract within ten (10) days after being notified to commence work by issuance of a Notice to Proceed in substantially the form contained herein from the Manager and agrees to fully complete said Work within **150 (One Hundred Fifty Days)** consecutive calendar days from the effective date of said Notice, plus such extension or extensions of time as may be granted in accordance with the provisions of the General Contract Conditions and any applicable Special Contract Conditions.

**4. TERMS OF PAYMENT**

The City agrees to pay the Contractor for the performance of all of the Work required under this Contract, and the Contractor agrees to accept as the Contractor's full and only compensation therefore, such sum or sums of money as may be proper in accordance with the price or prices set forth in the Contractor's Bid Form hereto attached and made a part hereof for the **base bid Lump Sum plus Alternates 1, 3 and 4, the total estimated cost thereof being One Million Eight Hundred Ten Thousand Dollars and No Cents (\$1,810,000.00)**. Adjustments to said Contract Amount and payment of amounts due hereunder shall be made in accordance with the provisions of the General Contract Conditions and any applicable Special Contract Conditions.

**5. NO DISCRIMINATION IN EMPLOYMENT**

In connection with the performance of the 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, marital status, or physical or mental disability; and the Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

**6. COMPLIANCE WITH M/WBE REQUIREMENT**

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 – 28-36 and 28-52 – 28-90 D.R.M.C. and referred to in this Contract as the "M/WBE Ordinance". Without limiting the general applicability of the foregoing, the Contractor acknowledges its continuing duty, pursuant to Sections 28-72, 28-73 and 28-75 of the D.R.M.C., to maintain throughout the duration of this Contract, compliance with the level of minority and Woman business enterprise participation, upon which the City approved the award of this Contract to the Contractor and the Contractor further acknowledges that failure to maintain such participation commitments or otherwise comply with the requirements of the M/WBE Ordinance shall

subject the Contractor to sanctions in accordance with Section 28-77 of the D.R.M.C. Nothing contained in this provision or in the M/WBE Ordinance shall negate the City's right to prior approval of subcontractors, or substitutes therefore, under this Contract

**7. WAGE RATE REQUIREMENTS**

In performance of all Work hereunder, the Contractor agrees to comply with and be bound by all requirements and conditions of the City's Payment of Prevailing Wages Ordinance, Sections 20-76 through 20-79, D.R.M.C. and any determinations made by the City pursuant thereto.

**8. APPLICABILITY OF LAWS**

The Agreement between the Contractor and the City shall be deemed to have been made in the City and County of Denver, State of Colorado and shall be subject to, governed by, and interpreted and construed by or in accordance with the laws of the State of Colorado and the Charter, Revised Municipal Code, Rules, Regulations, Executive Orders and fiscal rules of the City. As such, the Contractor shall at all times comply with the provisions of the Charter, Revised Municipal Code, Rules, Regulations, Executive Orders and fiscal rules of the City, and those State of Colorado and Federal Laws, Rules and Regulations, which in any manner limit, control or apply to the actions or operations of the Contractor, any subcontractors, employees, agents or servants of the Contractor engaged in the Work or affecting the materials and equipment used in the performance of the Work, as the same may be, from time to time, promulgated, revised or amended. The Charter and Revised Municipal Code of the City and County of Denver, as the same may be amended from time to time, are hereby expressly incorporated into this Agreement as if fully set out herein by this reference.

**9. APPROPRIATION**

The amount of money, which has been appropriated and encumbered for the purpose of this contract, to date, is equal to or in excess of the Contract Amount. The Manager, upon reasonable written request, will advise the Contractor in writing of the total amount of appropriated and encumbered funds, which remain available for payment for all Work under the Contract.

The issuance of any change order or other form or order or directive by the City which would cause the aggregate payable under the contract to exceed the amount appropriated for the contract is expressly prohibited. In no event shall the issuance of any change order or other form of order or directive by the City be considered valid or binding if it requires additional compensable work to be performed, which work will cause the aggregate amount available under the Contract to exceed the amount appropriated and encumbered for this Contract, unless and until such time as the Contractor has been advised in writing by the Manager that a lawful appropriation, sufficient to cover the entire cost of such additional work, has been made.

It shall be the responsibility of the Contractor to verify that the amounts already appropriated for this Contract are sufficient to cover the entire cost of such work, and any work undertaken or performed in excess of the amount appropriated is undertaken or performed in violation of the terms of this contract, without the proper authorization for such work, and at the Contractor's own risk.

**10. APPROVALS**

In the event this Contract calls for the payment by the City of five hundred thousand dollars (\$500,000.00) 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 effect and performance of this contract.

**11. ASSIGNMENT**

The Contractor shall not assign any of its rights, benefits, obligations or duties under this Contract except upon the prior written consent and approval of the Manager to such assignment.

**12. DISPUTES RESOLUTION PROCESS**

It is the express intention of the parties to this Contract that all disputes of any nature whatsoever regarding the Contract including, but not limited to, any claims for compensation or damages arising out of breach or default under this Contract, shall be resolved by administrative hearing pursuant to the provisions of Section 56-106, D.R.M.C., or, as applicable, Section 28-33 D.R.M.C. for Minority and Woman Business

Enterprise disputes. The Contractor expressly agrees that this dispute resolution process is the only dispute resolution mechanism that will be recognized by the parties for any claims put forward by the Contractor, notwithstanding any other claimed theory of entitlement on the part of the Contractor or its subcontractors or suppliers.

**13. 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.

**14. PARAGRAPH HEADINGS**

The captions and headings set forth herein are for convenience of reference only and shall not be construed so as to define or limit the terms and provisions hereof.

**15. SEVERABILITY**

It is understood and agreed by the parties hereto that, if any part, term, or provision of this Contract, except for the provisions of this Contract requiring prior appropriation and limiting the total amount to be paid by the City, is by the courts held to be illegal or in conflict with any law of the State of Colorado, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular part, term or provision held to be invalid.

IN WITNESS WHEREOF, the parties have caused these presents to be signed personally or by their duly authorized officers or agents and their seals affixed and duly attested the day and year first above written.

ATTEST:

Stephanie Y. O'Malley, Clerk and Recorder,  
Ex-Officio Clerk of the City and County of Denver

CITY AND COUNTY OF DENVER

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

REGISTERED AND COUNTERSIGNED:

\_\_\_\_\_  
MAYOR

\_\_\_\_\_  
Manager of Finance  
Contract Control Number: CE00767

RECOMMENDED AND APPROVED:

\_\_\_\_\_  
Dennis Gallagher, Auditor of the City and County of  
Denver

\_\_\_\_\_  
MANAGER OF PUBLIC WORKS

**PARTY OF THE FIRST PART**

APPROVED AS TO FORM:

David R. Fine, Attorney for the City and County  
of Denver

Contractor: \_\_\_\_\_

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

IRS Number: \_\_\_\_\_

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

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

ATTEST: \_\_\_\_\_  
Secretary

**PARTY OF THE SECOND PART**

IN WITNESS WHEREOF, the parties have executed this agreement and affixed their seals at Denver, Colorado as of the day first above written.

**Contract Control Number: 201100583 (Formerly CE00767)**

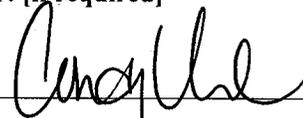
**Vendor Name: Ash & White Construction dba  
White Construction Group, LTD.**

By: 

Name: Douglas E Decker  
(please print)

Title: Vice President  
(please print)

**ATTEST: [if required]**

By: 

Name: Courtney White  
(please print)

Title: Secretary  
(please print)

**Contract Control Number:**

**Vendor Name:**

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 \_\_\_\_\_



**CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS**

**General Contract Conditions**

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# CITY AND COUNTY OF DENVER

## DEPARTMENT OF PUBLIC WORKS

### SPECIAL CONTRACT CONDITIONS

#### SC-1 CONSTRUCTION SPECIFICATIONS

Except as amended herein or in the attached Technical Specifications, all Work performed under the terms of this Contract shall be governed by the applicable provisions of the following latest editions:

City and County of Denver:

*Standard Specifications for Construction, GENERAL CONTRACT CONDITIONS,*  
(The Index for which is bound herein and commonly referred to as the "Orange Book")  
(1999 Edition)

*Transportation Standards and Details for the Engineering Division*

*City and County of Denver Traffic Standard Drawings*

Wastewater Management Division

– *Standard Detail Drawings*

– *Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications*

Colorado Department of Transportation:

*Standard Specifications for Road and Bridge Construction*  
(Sections 200 through 700 of the 2005 Edition)

Federal Highway Administration:

*Manual on Uniform Traffic Control Devices for Streets & Highways (MUTCD)*

Building & Fire Codes:

*Building Code of the City and County of Denver*  
(International Building Code 2006 Series, City and County of Denver Amendments 2006)

*National Fire Protection Association Standards*

(As referenced in the Building Code of the City and County of Denver)

The aforementioned City and County of Denver documents are available for review at the Capital Projects Management Office, 201 W. Colfax Ave., Dept. 506, (5<sup>th</sup> floor), Denver, CO 80202. The *Standard Specifications for Construction, GENERAL CONTRACT CONDITIONS* is available for purchase at the Cashier, 2<sup>nd</sup> floor at 201 W. Colfax Ave., Denver, Colorado 80202. *Transportation Standards and Details for the Engineering Division* and the Wastewater Management Division – *Standard Detail Drawings*, are available at <http://www.denvergov.org>.

The "Colorado Department of Transportation *Standard Specifications for Road and Bridge Construction*" is available for review on CDOT's website at <http://www.coloradodot.info/> and can be purchased from the Colorado Department of Transportation.

The *Manual on Uniform Traffic Control Devices for Streets & Highways* is available for review at the Federal Highway Administration Website at: [www.fhwa.dot.gov](http://www.fhwa.dot.gov), The FHWA website also contains purchasing information.

#### SC-2 CONSTRUCTION DOCUMENTS

The construction documents consist of Plans, Technical Specifications and, if applicable, Drawings as identified in the Index for Contract Drawings, the Index for Technical Specifications and any additional Plans attached hereto.

**SC-3 DEPUTY MANAGER / CITY ENGINEER**

General condition 109 DEPUTY MANAGER is hereby deleted in its entirety and replaced with the following:

The "Deputy Manager" means the official who reports directly to the Manager and exercises supervisory responsibility in the City agency defined in Title 2 herein that is responsible for the Project. The Manager hereby designates the City Engineer as the Deputy Manager for purposes of this Contract. The City Engineer shall have responsibility for this Project and shall undertake all duties, responsibilities, rights and authority, including specific actions and decisions, delegated to the Deputy Manager under the various terms and conditions of this Contract.

**SC-4 ENGINEERING DIVISION / CITY ENGINEER**

General Condition 206, TRANSPORTATION DIVISION, is hereby deleted in its entirety and replaced with the following:

The Engineering Division is a unit of the Department of Public Works and is supervised by the City Engineer, who is subordinate to the Manager of Public Works. This Division is responsible for the planning, design, construction, operation and maintenance of all of the City's transportation facilities and the planning, design and construction of all of the City's wastewater facilities, except for the City's Municipal Airport System. All other references to the Transportation Division or the Deputy Manager of Public Works for Transportation are deleted and replaced with references to the Engineering Division and City Engineer, respectively.

**SC-5 WASTEWATER MANAGEMENT DIVISION**

General Condition Section 208, WASTEWATER MANAGEMENT DIVISION, is hereby deleted in its entirety and replaced with the following:

The Wastewater Management Division is a unit of the Department of Public Works and is supervised by the Deputy Manager of Public Works for Wastewater Management, who is subordinate to the Manager of Public Works. This Division is responsible for the operation and maintenance of the City's wastewater facilities.

**SC-6 CITY DELEGATION OF AUTHORITY**

With reference to General Contract Condition 109, DEPUTY MANAGER, General Contract Condition 206, ENGINEERING DIVISION and General Contract Condition 214, CITY'S CONTRACT ADMINISTRATION LINE OF AUTHORITY, the Manager hereby designates the City Engineer as the City official responsible for those certain actions and decisions designated as the responsibility of the Deputy Manager under the General Conditions and delegates to the City Engineer the authority necessary to undertake those responsibilities under this Contract. The Director shall have supervisory responsibility over the Project Manager. Additionally, Contractor questions concerning the Plans and Technical Specifications shall be directed to:

**Denver Department of Public Works / Engineering Division,**

Project Manager  
City Project Manager  
Robert Alson

Telephone  
  
(720) 913-8821

Consultant  
Design Consultant  
Dennis Reseutek

Name  
Consultant Contact  
DRA Architecture, LLC

Telephone  
  
(303) 575-6800

**SC-7 LIQUIDATED DAMAGES**

Should the Contractor fail to complete all Work within the Contract Time allocated under the Contract Form at Paragraph 3, TERMS OF PERFORMANCE, the Contractor shall become liable to the City and County of Denver for liquidated damages, and not as a penalty, at the rate of \$400.00 for each Day that the Contractor exceeds the time limits herein specified, all in accordance with provisions of General Contract Condition 602, LIQUIDATED DAMAGES; ADMINISTRATIVE COSTS; ACTUAL DAMAGES.

Representative hourly rates for the City administrative costs described in General Contract Condition 602.2 shall be as follows for this Project:

Project Manager	\$69 per hour
Project Engineer	\$63 per hour
Inspector	\$49 per hour
Surveying, if necessary	\$100 per hour

**SC-8 SUBCONTRACTS**

In accordance with General Contract Condition 501, SUBCONTRACTS, no limit shall apply to that percentage of the Work, which may be sublet providing that the subcontractors receive prior approval in accordance with General Contract Condition 502, SUBCONTRACTOR ACCEPTANCE.

**SC-9 PAYMENTS TO CONTRACTORS**

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

<u>Agency/Firm</u>	<u>Name</u>	<u>Telephone</u>
Public Works/Engineering Division		

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 a completed Partial or Final Release Form, as appropriate, from EACH subcontractor and supplier, **AND** the Contractors' Certification of Payment Form. The forms, Final/Partial Release and Certificate of Payment (Subcontractor/Supplier) and the Contractor's Certification of Payment, either of which must be used are as follows:

DEPARTMENT OF PUBLIC WORKS  
Engineering Division

FINAL/PARTIAL RELEASE AND CERTIFICATE OF PAYMENT  
(SUBCONTRACTOR/SUPPLIER)

\_\_\_\_\_  
(PROJECT NO. and NAME)

Date: \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
(NAME OF CONTRACTOR)

Subcontract #: \_\_\_\_\_.

\_\_\_\_\_  
(NAME OF SUBCONTRACTOR/SUPPLIER)

Subcontract Value: \$ \_\_\_\_\_.

Last Progress Payment: \$ \_\_\_\_\_.

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

Total Paid to Date: \$ \_\_\_\_\_.

Date of Last Work: \_\_\_\_\_.

Check Applicable Box:

MBE     WBE

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.

In consideration of \$ \_\_\_\_\_ representing the Last Progress Payment referenced above and in further consideration of the Total Paid to Date, also referenced above, and other good and valuable consideration received and accepted by the undersigned this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, the Undersigned hereby releases and discharges the City and County of Denver (the "City"), the above referenced City Project, the City's premises and property and the above referenced Contractor from all claims, liens, rights, liabilities, demands and obligations, whether known or unknown, of every nature arising out of or in connection with the performance of the work effort.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and save 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.

STATE OF COLORADO    ) ss.  
CITY OF \_\_\_\_\_ )

\_\_\_\_\_  
(Name of Subcontractor)

Signed and sworn before me this  
day of \_\_\_\_\_, 20\_\_.

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

\_\_\_\_\_  
Notary Public/Commissioner of Oaths  
My Commission Expires

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



**City and County of Denver**

**Contractor's Certification of Payment (CCP)**

Office of Economic Development  
 Compliance Unit  
 201 W. Colfax Ave., Dept 907  
 Denver, CO 80202  
 Phone: 720.913.1999  
 Fax: 720.913.1803

Pay Application #:		Pay Period:		Amount Requested: \$					
Project #:		Project Name:							
Current Completion Date:		Percent Complete:		Prepared By:					
Contractor:		Phone:		Project Manager:					
(I) - Original Contract Amount: \$		(II) - Current Contract Amount: \$							
Prime/Subcontractor/Supplier Name	MBE WBE	A Original Contract Amount	B % Bid (A/I)	C Current Contract Amount including Amendments	D % Revised (C/I)	E Requested Amount this Pay Application	F Amount Paid Previous Pay	G Net Paid To Date	H Paid % Achieved (G/II)
Total									
<p>The undersigned certifies that the information contained in this document is true, accurate and that the payments shown have been made to all subcontractors and suppliers used on this project and listed herein.</p>									
Prepared By (Signature):						Date:			

Page of

Rev. Contractors Certification of Payment (CCP)-1/07 dm

Contract No. CE00767  
 CHERRY CREEK TRANSFER STATION ADDS

BDP - 40

December 7, 2010



Office of Economic Development  
Division of Small Business Opportunity  
Compliance Unit  
201 West Colfax Avenue, Dept. 907  
Denver, CO 80202  
Phone: 720-913-1999  
Fax: 720.913-1803

### Instructions for Completing the Contractor/Consultant Certification of Payment Form

**Note:** The attached Contractor/Consultant Certification of Payment form must be completed by the Contractor/Subconsultant and all subcontractors/subconsultant or suppliers used on the project at **any tier** and submitted with each pay application. The Contractor/Consultant is responsible for the accuracy of all information provided and is required to have each subcontractor/subconsultant or supplier fill out the appropriate forms. Please be sure to complete all information requested at the top of the form, including the name of the person who prepared this form.

If you reproduce this form, you must continue to list each of the originally listed firms, as well as any additional firms used during the performance period of the contract.

If you have any questions, please call the Compliance Unit of DSBO at 720.913.1999.

### Instructions for Completing the Contractor/Consultant Certification of Payment Form, per Column

**Contractor/Subcontractor or Subconsultant/Supplier Name:** In the space provided, list all subcontractors/subconsultants and suppliers used on the project. For all MBE/WBEs use the exact name listed in the DSBO Directory.

**MBE/WBE/NON:** For each name listed, indicate whether the entity is a certified MBE/WBE.

**Column A:** Provide the contract amount, as listed at bid time, for the Contractor/Consultant and each subcontractor/subconsultant or supplier.

**Column B:** Provide the percentage portion of each listed subcontractor/subconsultant or supplier contract amount (Column A) compared to the total original contract amount in (I).

**Column C:** Provide the original contract amount (Column A) for each subcontractor/subconsultant or supplier plus any awarded alternate and/or change order amounts applicable. If an alternate/change order does not apply to the listed firm, re-enter the original contract amount (Column A).

**Column D:** Provide the percent portion of each listed subcontractor/subconsultant or supplier contract amount (Column C) compare to the current total contract amount in (II).

**Column E:** Provide the amount requested for work performed or materials supplied by each listed subcontractor/subconsultant or supplier for this pay application. The sum of the items in this column should equal the estimated amount requested for this pay application.

**Column F:** Provide the amount paid to each subcontractor/subconsultant or supplier on the previous pay application. Enter the previous pay application number in the column heading. The sum of the items listed in this column should equal the warrant amount paid to the Contractor/Consultant on the previous pay application. The amounts paid to the subcontractor/subcontractor or suppliers should be the actual amount of each check issued.

**Column G:** Provide the net paid to date for the Contractor/Subconsultant and each listed subcontractor/subconsultant or supplier.

**Column H:** Provide the percent portion of the net paid to date (Column G) for the Contractor/Subconsultant and each listed subcontractor/subconsultant or supplier of the current total contract amount in (II).

Rev. MBE/WBE Pre-Pre Conf. Instruction for Contractor/Consultant Certification of Payment 1/07-dm

**SC-10 WAGE RATE REQUIREMENTS**

General Contract Title 10 shall be amended by adding the following:

All work that has specialized skills or that has safety concerns shall be performed by the appropriate level tradesman including, but not limited to, work on energized, or potentially energized, electrical circuits until the circuit has been positively identified as having been de-energized; work on pressurized piping; work on potable waterlines; shoring and scaffolding; work involving handling refrigerants and hazardous materials; heavy equipment operation and work involving asbestos. Work not involving energized circuits, pressurized piping, etc. may be performed by personnel in demolition laborer classifications.

Without limiting the foregoing, the work of drayage shall include all work performed by drivers and workers in connection with the hauling and transport of materials and debris to and from the work site, where such work is part of any continuous hauling or transport effort either originating or terminating directly upon the site of the work. Such drivers and workers shall be paid at the then-current prevailing wage rates designated: TRUCK DRIVER, HEAVY AND HIGHWAY CONSTRUCTION PROJECTS, Prevailing Rate Schedule, for all time spent loading, hauling and unloading materials and debris, regardless of the location of such work.

**SC-11 MINORITY BUSINESS ENTERPRISES AND WOMEN BUSINESS ENTERPRISES**

In a March 7, 2000 opinion and order of the United States District Court for the District of Colorado, all terms, provisions and requirements relating to the implementation and enforcement of Article III, Divisions I and III, of Chapter 28 of the Denver Revised Municipal Code, (the "MBE/WBE Requirements") in effect as of the adoption of the General Conditions in 1999 were held invalid, and they are hereby deleted. All such terms, provisions and requirements in the General Conditions are hereby replaced with references to the following later-enacted ordinances:

- Denver Revised Municipal Code, Chapter 28 Article III, Division 1 (Sections 28-31 to 28-36) (establishment of Small Business Opportunity Division, "DSBO");
- Denver Revised Municipal Code, Chapter 28 Article III, Division 3 (Sections 28-52 to 28-83) (the "MBE/WBE Requirements"); and
- Denver Revised Municipal Code, Chapter 28, Article VII (Sections 28-201 to 28-234) (the "SBE Requirements").

Such revised provisions of the General Conditions include, without limitation, General Contract Condition 210.

**SC-12 CONTRACT FORMS**

In accordance with the terms and conditions of the Contract Documents, the City requires the use of certain form documents in complying with or satisfying various obligations, notifications and conditions in contracting with the City or performing Work hereunder. These form documents are referenced by title throughout the Contract Documents for mandatory use as directed. The following are the forms that shall be detached and utilized in accordance with the Contract Documents:

1. Performance and Payment Bond
2. Performance and Payment Bond Surety Authorization Letter (Sample)

The following are forms that will be issued by the City during construction:

1. Notice to Apparent Low Bidder (Sample)
2. Notice To Proceed (Sample)
3. Certificate of Contract Release (Sample)

**SC-13 CONSTRUCTION INSPECTION BY THE CITY**

General Condition 1701, CONSTRUCTION INSPECTION BY THE CITY, is modified as follows:

**1701** Persons who are employees of the City or who are under contract to the City or the City as lessee will be assigned to inspect and test the Work. These persons may perform any tests and observe the Work to determine whether or not designs, materials used, manufacturing and construction processes and methods applied, and equipment installed satisfy the requirements of the drawings and specifications, accepted Shop Drawings, Product Data and Samples, and the General Contractor's warranties and guarantees. The General Contractor shall permit these inspectors unlimited access to the Work and provide means of safe access to the Work, which cost shall be included as a Cost of the Work without any increase to the Guaranteed Maximum Price. In addition, General Contractor shall

provide whatever access and means of access are needed to off-site facilities used to store or manufacture materials and equipment to be incorporated into the Work and shall respond to any other reasonable request to further the inspector's ability to observe or complete any tests. Such inspections shall not relieve the General Contractor of any of its quality control responsibilities or any other obligations under the Contract. All inspections and all tests conducted by the City are for the convenience and benefit of the City. These inspections and tests do not constitute acceptance of the materials or Work tested or inspected, and the City may reject or accept any Work or materials at any time prior to the inspections pursuant to G.C. 2002, whether or not previous inspections or tests were conducted by the inspector or a City representative.

.2 The Building Inspection Division will perform building code compliance inspections for structures designed for human occupancy. It is the General Contractor's responsibility to schedule and obtain these inspections. If a code compliance inspection results in identification of a condition which will be at variance to the Contract Documents, the General Contractor shall immediately notify the Project Manager and confirm such notification with formal correspondence no later than forty-eight (48) hours after the occurrence.

.3 When any unit of government or political subdivision, utility or railroad corporation is to pay a portion of the cost of the Work, its respective representatives shall have the right to inspect the Work. This inspection shall not make any unit of government or political subdivision, utility or railroad corporation a party to the Contract, and shall not interfere with the rights of either party.

#### **SC-14 DISPOSAL OF NON-HAZARDOUS WASTE AT DADS**

In accordance with the Landfill Agreement made between the City and Waste Management of Colorado, Inc., bidders will be required to haul dedicated loads (non-hazardous entire loads of waste) to the Denver-Arapahoe Disposal Site ("DADS") for disposal. DADS is located at Highway 30 and Hampden Avenue in Arapahoe County, Colorado. The City will pay all fees associated with such disposal but the bidder shall be responsible for the costs of transporting the loads. Non-hazardous waste is defined as those substances and materials not defined or classified as hazardous by the Colorado Hazardous Waste Commission pursuant to C.R.S. §25-15-101(6), as amended from time to time, and includes construction debris, soil and asbestos. Bidders shall not use Gun Club Road between I-70 and Mississippi Avenue as a means of access to DADS.

#### **SC-15 PROHIBITION ON USE OF CCA-TREATED WOOD PRODUCTS**

The use of any wood products pressure-treated with chromated copper arsenate (CCA) is prohibited. Examples of CCA-treated wood products include wood used in play structures, decks, picnic tables, landscaping timbers, fencing, patios, walkways and boardwalks.

#### **SC-16 WAIVER OF: PART 8 OF ARTICLE 20 OF TITLE 13, COLORADO REVISED STATUTES.**

The Contractor specifically waives all the provisions of Part 8 of Article 20 of Title 13, Colorado Revised Statutes regarding defects in the Work under this Construction Contract.

#### **SC-17 DEBARRED SUBCONTRACTORS PROHIBITED**

The Contractor is prohibited from hiring any subcontractor currently debarred by the City in accordance with section 20-77 of the Denver Revised Municipal Code.

#### **SC-18 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, the Contractor agrees to pay to the City its costs and a reasonable attorney's fee which cost shall be included as a Cost of the Work.

Because the City Attorney Staff does not bill the City for legal services on an hourly basis, the Contractor agrees a reasonable fee shall be computed at the rate of one hundred dollars per hour of City Attorney time.

#### **SC 19: INSURANCE:**

General Condition 1601 is hereby deleted in its entirety and replaced with the following:

(1) **General Conditions:** Contractor agrees to secure, at or before the time of execution of this Agreement, the following insurance covering all operations, goods or services provided pursuant to this Agreement. Contractor shall keep the required insurance coverage in force at all times during the term of the Agreement, or any extension thereof, during any warranty period, and for eight (8) years after termination of the Agreement. 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. Each policy shall contain a valid provision or endorsement stating "Should any of the above-described policies be canceled or non-renewed

before the expiration date thereof, the issuing company shall send written notice to Denver Risk Management, 201 West Colfax Avenue, Dept. 1105, Denver, Colorado 80202. Such written notice shall be sent thirty (30) days prior to such cancellation or non-renewal unless due to non-payment of premiums for which notice shall be sent ten (10) days prior." Additionally, Contractor shall provide written notice of cancellation, non-renewal and any reduction in coverage to the address above by certified mail, return receipt requested. If any policy is in excess of a deductible or self-insured retention, the City must be notified by the Contractor. Contractor shall be responsible for the payment of any deductible or self-insured retention. The insurance coverages specified in this Agreement are the minimum requirements, and these requirements do not lessen or limit the liability of the Contractor. The Contractor shall maintain, at its own expense, any additional kinds or amounts of insurance that it may deem necessary to cover its obligations and liabilities under this Agreement.

(2) **Proof of Insurance:** Contractor shall provide a copy of this Agreement to its insurance agent or broker. Contractor may not commence services or work relating to the Agreement prior to placement of coverage. Contractor certifies that the certificate of insurance attached as part of the Contract Documents, preferably an ACORD certificate, complies with all insurance requirements of this Agreement. The City requests that the City's contract number be referenced on the Certificate. The City's acceptance of a certificate of insurance or other proof of insurance that does not comply with all insurance requirements set forth in this Agreement shall not act as a waiver of Contractor's breach of this Agreement or of any of the City's rights or remedies under this Agreement. The City's Risk Management Office may require additional proof of insurance, including but not limited to policies and endorsements.

(3) **Additional Insureds:** For Commercial General Liability and Auto Liability, Contractor and subcontractor's insurer(s) shall name the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured.

(4) **Waiver of Subrogation:** For all coverages, Contractor's insurer shall waive subrogation rights against the City.

(5) **Subcontractors and Subconsultants:** All subcontractors and subconsultants (including independent contractors, suppliers or other entities providing goods or services required by this Agreement) shall be subject to all of the requirements herein and shall procure and maintain the same coverages required of the Contractor. Contractor shall include all such subcontractors as additional insured under its policies (with the exception of Workers' Compensation) or shall ensure that all such subcontractors and subconsultants maintain the required coverages. Contractor agrees to provide proof of insurance for all such subcontractors and subconsultants upon request by the City.

(6) **Workers' Compensation/Employer's Liability Insurance:** Contractor shall maintain the coverage as required by statute for each work location and shall maintain Employer's Liability insurance with limits of \$100,000 per occurrence for each bodily injury claim, \$100,000 per occurrence for each bodily injury caused by disease claim, and \$500,000 aggregate for all bodily injuries caused by disease claims. 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, and that any such rejections previously effected, have been revoked as of the date Contractor executes this Agreement.

(7) **Commercial General Liability:** Contractor shall maintain a Commercial General Liability insurance policy with limits of \$1,000,000 for each occurrence, \$1,000,000 for each personal and advertising injury claim, \$2,000,000 products and completed operations aggregate, and \$2,000,000 policy aggregate.

(8) **Business Automobile Liability:** Contractor shall maintain Business Automobile Liability with limits of \$1,000,000 combined single limit applicable to all owned, hired and non-owned vehicles used in performing services under this Agreement

(9) **Builders' Risk or Installation Floater:** Contractor shall maintain limits equal to the completed value of the project. Coverage shall be written on an all risk, replacement cost basis including coverage for soft costs, flood and earth movement, if in a flood or quake zone, and, if applicable, equipment breakdown including testing. Contractor is responsible for payment of all policy deductibles. The City and County of Denver, Contractor, and sub-contractors shall be named insureds under the policy. Policy shall remain in force until acceptance of the project by the City.

(10) **Additional Provisions:**

(a) For Commercial General Liability, the policy must provide the following:

- (i) That this Agreement is an Insured Contract under the policy;
- (ii) Defense costs in excess of policy limits;
- (ii) A severability of interests, separation of insureds or cross liability provision; and
- (iii) A provision that coverage is primary and non-contributory with other coverage or self-insurance maintained by the City.

(b) For claims-made coverage:

- (i) 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

(c) Contractor shall advise the City in the event any general aggregate or other aggregate limits are reduced below the required per occurrence limits. At their own expense, and where such general aggregate or other aggregate limits have been reduced below the required per occurrence limit, the

Contractor will procure such per occurrence limits and furnish a new certificate of insurance showing such coverage is in force.

**SC-20 DEFENSE AND INDEMNIFICATION**

General Condition 1602, INDEMNIFICATION, is modified to read in full as follows:

**DEFENSE AND INDEMNIFICATION**

- (a) To the fullest extent permitted by law, the Contractor hereby agrees to defend, indemnify, and hold harmless City, its appointed and elected officials, agents and employees against all liabilities, claims, judgments, suits or demands for damages to persons or property arising out of, resulting from, or related to the work performed under this Contract that are due to the negligence or fault of the Contractor or the Contractor's agents, representatives, subcontractors, or suppliers ("Claims"). This indemnity shall be interpreted in the broadest possible manner consistent with the applicable law to indemnify the City.
- (b) Contractor's duty to defend and indemnify City shall arise at the time written notice of the Claim is first provided to City regardless of whether suit has been filed and even if Contractor is not named as a Defendant.
- (c) Contractor will defend any and all Claims which may be brought or threatened against City and will pay on behalf of City any expenses incurred by reason of such Claims including, but not limited to, court costs and attorney fees incurred in defending and investigating such Claims or seeking to enforce this indemnity obligation. Such payments on behalf of City shall be in addition to any other legal remedies available to City and shall not be considered City's exclusive remedy.
- (d) Insurance coverage requirements specified in this Contract shall in no way lessen or limit the liability of the Contractor under the terms of this indemnification obligation. The Contractor shall obtain, at its own expense, any additional insurance that it deems necessary for the City's protection.
- (e) This defense and indemnification obligation shall survive the expiration or termination of this Contract.

**SC-21 GREENPRINT DENVER REQUIREMENTS**

In accordance with the City and County of Denver Executive Order 123: Greenprint Denver Office and Sustainability Policy (dated October 27, 2007), and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program, Contractor shall, wherever possible, recycle construction and demolition waste, and install building materials that contain recycled content. Non-hazardous solid waste that is eligible for reuse or recycling is not subject to the DADS disposal requirement defined in SC-14. The Contractor shall recycle and/or reuse construction and demolition waste and implement sustainable development practices on construction projects in compliance with any Project Requirements of the Better Denver Program Sustainability Form that are included in the Contract Documents.

At the Project Pre-Construction Meeting, the Contractor shall provide a written summary of how the Contractor intends to meet any applicable Project Requirement, and the type of documentation to be provided. The Contractor shall maintain and keep current documentation of the materials recycled or reused, organized in accordance with any applicable Closeout Form for Contractors provided in the Contract Documents for the duration of the Project. A copy of the completed Closeout Form, the quantity tabulation, and all supporting documentation for materials reused or recycled shall be delivered to the Project Manager as a submittal requirement of Final Acceptance.

**SC-22 CITY AUDITOR AND MANAGER OF FINANCE**

Section 211, City Auditor, of the General Contract Conditions, 1999 Edition, is amended to read in its entirety as follows:

**211 CITY AUDITOR AND MANAGER OF FINANCE**

The City Auditor, an independent elected official, reviews certified payrolls for compliance with prevailing wage requirements before payment is made to a Contractor. The City's Manager of Finance pays the Contractor for Work approved under the Contract.

**SC-23 NO EMPLOYMENT OF ILLEGAL ALIENS TO PERFORM WORK UNDER THE AGREEMENT:**

a. This Agreement is subject to Division 5 of Article IV of Chapter 20 of the Denver Revised Municipal Code, and any amendments (the "Certification Ordinance").

b. The Contractor certifies that:

- (1) At the time of its execution of this Agreement, it does not knowingly employ or contract with an illegal alien who will perform work under this Agreement.
- (2) It will participate in the E-Verify Program, as defined in § 8-17.5-101(3.7), C.R.S., to confirm the employment eligibility of all employees who are newly hired for employment to perform work under this Agreement.

c. The Contractor also agrees and represents that:

- (1) It shall not knowingly employ or contract with an illegal alien to perform work under the Agreement.
- (2) It shall not enter into a contract with a subconsultant or subcontractor that fails to certify to the Contractor that it shall not knowingly employ or contract with an illegal alien to perform work under the Agreement.
- (3) It has confirmed the employment eligibility of all employees who are newly hired for employment to perform work under this Agreement, through participation in the E-Verify Program.
- (4) It is prohibited from using the E-Verify Program procedures to undertake pre-employment screening of job applicants while performing its obligations under the Agreement, and that otherwise requires the Contractor to comply with any and all federal requirements related to use of the E-Verify Program including, by way of example, all program requirements related to employee notification and preservation of employee rights.
- (5) If it obtains actual knowledge that a subconsultant or subcontractor performing work under the Agreement knowingly employs or contracts with an illegal alien, it will notify such subconsultant or subcontractor and the City within three (3) days. The Contractor will also then terminate such subconsultant or subcontractor if within three (3) days after such notice the subconsultant or subcontractor does not stop employing or contracting with the illegal alien, unless during such three-day period the subconsultant or subcontractor provides information to establish that the subconsultant or subcontractor has not knowingly employed or contracted with an illegal alien.
- (6) It will comply with any reasonable request made in the course of an investigation by the Colorado Department of Labor and Employment under authority of § 8-17.5-102(5), C.R.S, or the City Auditor, under authority of D.R.M.C. 20-90.3.

d. The Contractor is liable for any violations as provided in the Certification Ordinance. If Contractor violates any provision of this section or the Certification Ordinance, the City may terminate this Agreement for a breach of the Agreement. If the Agreement is so terminated, the Contractor shall be liable for actual and consequential damages to the City. Any such termination of a contract due to a violation of this section or the Certification Ordinance may also, at the discretion of the City, constitute grounds for disqualifying Contractor from submitting bids or proposals for future contracts with the City.

**CITY AND COUNTY OF DENVER**  
**DEPARTMENT OF PUBLIC WORKS**

**PERFORMANCE AND PAYMENT BOND**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned White Construction Group, 18 S. Wilcox St., Suite 100, Castle Rock, CO 80104 a corporation organized and existing under and by virtue of the laws of the State of Colorado, hereafter referred to as the "Contractor", and The Hanover Insurance Company a corporation organized and existing under and by virtue of the laws of the State of New Hampshire and authorized to transact business in the State of Colorado, 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 One Million Eight Hundred Ten Thousand Dollars and No Cents (\$1,810,000.00), lawful money of the United States of America, for the payment of which sum, well and truly to be made, we bind ourselves and our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents;

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH THAT:

WHEREAS, the above bounden Contractor has entered into a written contract with the aforesaid City for furnishing all labor and tools, supplies, equipment, superintendence, materials and everything necessary for and required to do, perform and complete the construction of **CONTRACT NO. 201100583 (FormerlyCE00767) CHERRY CREEK TRANSFER STATION ADDITIONS**, Denver, Colorado, and has bound itself to complete the project within the time or times specified or pay liquidated damages, all as designated, defined and described in the said Contract and Conditions thereof, and in accordance with the Plans and Technical Specifications therefore, a copy of said Contract being made a part hereof;

NOW, THEREFORE, if the said Contractor shall and will, in all particulars well and truly and faithfully observe, perform and abide by each and every Covenant, Condition and part of said Contract, and the Conditions, Technical Specifications, Plans, and other Contract Documents thereto attached, or by reference made a part thereof and any alterations in and additions thereto, according to the true intent and meaning in such case, then this obligation shall be and become null and void; otherwise, it shall remain in full force and effect;

PROVIDED FURTHER, that if the said Contractor shall satisfy all claims and demands incurred by the Contractor in the performance of said Contract, and shall fully indemnify and save harmless the City from all damages, claims, demands, expense and charge of every kind (including claims of patent infringement) arising from any act, omission, or neglect of said Contractor, its agents, or employees with relation to said work; and shall fully reimburse and repay to the City all costs, damages, and expenses which it may incur in making good any default based upon the failure of the Contractor to fulfill its obligation to furnish maintenance, repairs or replacements for the full guarantee period provided in the Contract Documents, then this obligation shall be null and void; otherwise it shall remain in full force and effect;

PROVIDED FURTHER, that if said 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 that if the Contractor will indemnify and save harmless the City for the extent of any and all payments in connection with the carrying out of such Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect;

PROVIDED FURTHER, that if the said Contractor fails to duly pay for any labor, materials, team hire, sustenance, provisions, provender, gasoline, lubricating oils, fuel oils, grease, coal, or any other supplies or materials used or consumed by said Contractor or its subcontractors in 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 will pay the same in any 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 no change, extension of time, alteration or addition to the terms of the Contract, or to contracts with others in connection with this project, or the work to be performed thereunder, or the Technical Specifications and Plans accompanying the same, shall in any way affect its obligation on this bond and it does hereby waive notice of any change, extension of time, alteration or addition to the terms of the Contract, or contracts, or to the work, or to the Technical Specifications and Plans.

IN WITNESS WHEREOF, said Contractor and said Surety have executed these presents as of this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

**Ash & White Construction**  
**dba White Construction Group, LTD**  
**Contractor**

Attest:  
\_\_\_\_\_  
Secretary

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

**The Hanover Insurance Company**  
**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).

APPROVED AS TO FORM:  
Attorney for the City and County of Denver

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

APPROVED FOR THE CITY AND COUNTY OF  
DENVER

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

By: \_\_\_\_\_  
**MANAGER OF PUBLIC WORKS**



**DENVER**  
THE MILE HIGH CITY

**Department of Public Works**  
Engineering Department

201 W. Colfax Avenue  
Denver, CO 80202  
[www.denvergov.org/PublicWorks](http://www.denvergov.org/PublicWorks)

**PERFORMANCE AND PAYMENT BOND  
SURETY AUTHORIZATION  
(SAMPLE)**

FAX NUMBER: 720-913-3183  
TELEPHONE NUMBER: 720-913-3267

Assistant City Attorney  
201 W. Colfax Ave. Dept 1207  
Denver, Colorado 80202

RE: (Company name)

Contract No: CE00767  
Project Name: CHERRY CREEK TRANSFER STATION ADDITIONS  
Contract Amount:  
Performance and Payment Bond No.:

Dear Assistant City Attorney,

The Performance and Payment Bonds covering the above captioned project were executed by this agency, through \_\_\_\_\_ insurance company, on \_\_\_\_\_, 20\_\_.

We hereby authorize the City and County of Denver, Department of Public Works, to date all bonds and powers of attorney to coincide with the date of the contract.

If you should have any additional questions or concerns, please don't hesitate to give me a call at \_\_\_\_\_.

Thank you.

Sincerely,





**DENVER**  
THE MILE HIGH CITY

Department of Public Works  
Engineering Department

201 W. Colfax Avenue  
Denver, CO 80202  
[www.denvergov.org/PublicWorks](http://www.denvergov.org/PublicWorks)

**NOTICE OF APPARENT LOW BIDDER**  
**(SAMPLE)**

Current Date

To:

Gentlemen:

The MANAGER OF PUBLIC WORKS has considered the Bids submitted on January 06, 2011 for work to be done and materials to be furnished in and for:

**PROJECT No. CE00767 CHERRY CREEK TRANSFER STATION ADDITIONS**

as set forth in detail in the Contract Documents for the City and County of Denver, Colorado. It appears that your Bid is fair, equitable, and to the best interest of the City and County; therefore, said Bid is hereby accepted at the bid price contained herein, subject to execution of the Contract Documents and your furnishing the items specified below, the total cost thereof (Contract Amount Written), (Contract Amount Numeric).

It will be necessary for you to appear forthwith at the office of the Department of Public Works, Engineering Division, Project Management Office, 201 W. Colfax Ave., Dept 506, Denver, Colorado 80202, to receive the said Contract Documents, execute the same and return them to the Department of Public Works, Engineering Division, Project Management Office within the time limit set forth in the Bid Proposal.

In accordance with the requirements set forth in the Contract Documents, you are required to furnish the following documents:

- a. Insurance Certificates: General Liability and Automotive Liability, Workman's Compensation and Employer Liability; or any other coverage required by the contract; and
- b. One original plus four copies of the Power of Attorney relative to Performance and/or Payment Bond;

All construction Contracts made and entered into by the City and County of Denver are subject to Affirmative Action and Equal Opportunity Rules and Regulations, as adopted by the Manager of Public Works, and each contract requiring payment by the City of one-half million dollars (\$500,000.00) or more shall first be approved by the City Council acting by ordinance and in accordance with Section 3.2.6 of the Charter of the City and County of Denver.

Prior to issuance of Notice to Proceed, all Equal Opportunity requirements must be completed. Additional information may be obtained by contacting the Director of Contract Compliance at (720-913-1700).



**NOTICE OF APPARENT LOW BIDDER  
(SAMPLE)**

PROJECT NO. CE00767

Page 2

The Bid Security submitted with your Bid, will be returned upon execution of the Contract and furnishing of the Performance Bond. In the event you should fail to execute the Contract and to furnish the performance Bond within the time limit specified, said Bid Security will be retained by the City and County of Denver as liquidated damages, and not as a penalty for the delay and extra work caused thereby.

Dated at Denver, Colorado this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_.

CITY AND COUNTY OF DENVER

By

\_\_\_\_\_  
Guillermo V. Vidal  
Manager of Public Works



Department of Public Works  
Engineering Department

201 W. Colfax Avenue  
Denver, CO 80202  
[www.denvergov.org/PublicWorks](http://www.denvergov.org/PublicWorks)

Current Date

**NOTICE TO PROCEED  
(SAMPLE)**

Name  
Company  
Street  
City/State/Zip

**CONTRACT NO. CE00767, CHERRY CREEK TRANSFER STATION ADDITIONS**

In accordance with General Contract Condition 302 of the Standard Specifications for Construction, General Contract Conditions, 1999 Edition, you are hereby authorized and directed to proceed on \_\_\_\_\_ with the work of constructing contract number CE00767, as set forth in detail in the contract documents for the City and County of Denver.

With a contract time of \_\_\_\_\_ calendar days, the project must be complete on or before \_\_\_\_\_.

If you have not already done so, you must submit your construction schedule, in accordance with General Contract Condition 306.2.B, to the Project Manager within 10 days. Additionally, you must submit your tax exempt certificate, and copies of your subcontractors' certificates, in accordance with General Contract Condition 322.5, to the Project Manager as soon as possible. Failure to submit these certificates will delay processing of payment applications.

Sincerely,

Lesley B. Thomas  
City Engineer

cc:





**DENVER**  
THE MILE HIGH CITY

**Department of Public Works**  
Engineering Department

201 W. Colfax Avenue  
Denver, CO 80202  
[www.denvergov.org/PublicWorks](http://www.denvergov.org/PublicWorks)

Certificate of Contract Release  
(SAMPLE)

Date

Name

Company

Street

City/State/Zip

RE: Certificate of Contract Release for  
**CE00767, CHERRY CREEK TRANSFER STATION ADDITIONS**

Received this date of the City and County of Denver, as full and final payment of the cost of the improvements provided for in the foregoing contract, \_\_\_\_\_ dollars and \_\_\_\_\_ cents (\$\_\_\_\_\_), in cash, being the remainder of the full amount accruing to the undersigned by virtue of said contract; said cash also covering and including full payment for the cost of all extra work and material furnished by the undersigned in the construction of said improvements, and all incidentals thereto, and the undersigned hereby releases said City and County of Denver from any and all claims or demands whatsoever, regardless of how denominated, growing out of said contract.

And these presents are to certify that all persons performing work upon or furnishing materials for said improvements under the foregoing contract have been paid in full and this payment to be made is the last or final payment.

\_\_\_\_\_  
Contractor's Signature

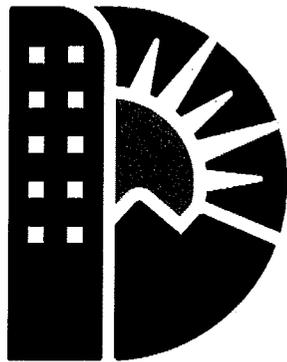
\_\_\_\_\_  
Date Signed

If there are any questions, please contact me by telephone at (720) 913-XXXX. Please return this document via facsimile at (720) 913-1805 and mail to original to the above address.



# CITY AND COUNTY OF DENVER

STATE OF COLORADO



**DENVER**<sup>®</sup>  
THE MILE HIGH CITY

## PREVAILING WAGE RATES

**Contract No. 201100583**  
**Formerly CE00767**

---

**CHERRY CREEK TRANSFER STATION**  
**ADDITIONS**

**December 7, 2010**



**DENVER**  
THE MILE HIGH CITY

**Career Service Authority**  
Denver's Human Resource Agency

201 W. Colfax, Department 412  
Denver, CO 80202  
p: 720.913.5751  
f: 720.913.5720  
[www.denvergov.org/csa](http://www.denvergov.org/csa)

TO: All Users of the City of Denver Prevailing Wage Schedules  
FROM: Meredith Creme, Staff Human Resources Professional  
DATE: Friday October 15, 2010  
SUBJECT: Latest Change to Prevailing Wage Schedules

The Career Service Authority Board in their meeting held on November 3, 2005, approved to use the last comprehensive prevailing wage schedule for Heavy and Highway projects, which was published on March 1, 2002, to fill in for missing rates from subsequent Heavy and Highway wage schedules. The missing rates will be provided as supplemental to the Davis Bacon Heavy and Highway rates issued by CSA.

With regards to the Building rates, the last comprehensive prevailing wage schedule for Building projects which was published on November 9, 2001 will continue to be used to fill in for missing rates from subsequent Building Construction schedules. The missing rates will be provided as supplemental to the Davis-Bacon Building rates issued by CSA.

The attached Prevailing Wage Schedule is effective as of **Friday October 15, 2010** 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. CO080004  
Superseded General Decision No. CO20070004  
Modification No. 9  
Publication Date: 10-08-2010  
(5 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) 913-5009

Attachments as listed above.

General Decision Number: CO100004 10/08/2010 CO4

Superseded General Decision Number: CO20080004

State: Colorado

Construction Type: Building

County: Denver County in Colorado.

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	03/12/2010
1	05/21/2010
2	06/04/2010
3	07/02/2010
4	07/09/2010
5	07/16/2010
6	08/06/2010
7	08/13/2010
8	09/24/2010
9	10/08/2010

ASBE0028-001 07/01/2010

	Rates	Fringes
Asbestos Workers/Insulator (Includes application of all insulating materials, protective coverings, coatings and finishings to all types of mechanical systems).....	\$ 24.74	11.13

BRCO0007-001 01/01/2010

	Rates	Fringes
BRICKLAYER.....	\$ 22.48	9.54

BRCO0007-005 05/01/2009

	Rates	Fringes
TILE SETTER.....	\$ 25.65	8.83

CARP0001-004 05/01/2009

	Rates	Fringes
Carpenters: Acoustical, Drywall		

Hanging/Framing and Metal  
 Stud, Form Building/Setting.\$ 26.60 8.89

-----  
 CARP2834-001 05/01/2009

	Rates	Fringes
MILLWRIGHT.....	\$ 27.60	10.65

-----  
 \* ELEC0068-002 06/01/2010

	Rates	Fringes
ELECTRICIAN (Includes Low Voltage Wiring and Installation of Fire alarms, Security Systems, Telephones, Computers and Temperature Controls).....	\$ 31.60	12.32

-----  
 ELEV0025-002 01/01/2010

	Rates	Fringes
Elevator Constructor.....	\$ 36.94	20.24

FOOTNOTE:

a. Employer contributes 8% of basic hourly rate for over 5 years' service and 6% basic hourly rate for 6 months' to 5 years' service as Vacation Pay Credit.

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

-----  
 ENGI0009-003 05/01/2009

	Rates	Fringes
Power equipment operator - crane		
141 tons and over.....	\$ 24.88	9.22
50 tons and under.....	\$ 23.82	9.22
51 to 90 tons.....	\$ 23.97	9.22
91 to 140 tons.....	\$ 24.12	9.22

-----  
 IRON0024-001 11/01/2009

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 24.80	9.91

-----  
 LABO0720-003 05/01/2009

	Rates	Fringes
--	-------	---------

Laborers:		
Concrete/Mason Tenders.....	\$ 16.52	6.84
-----		
PAIN0079-002 08/01/2009		
	Rates	Fringes
Drywall Finisher/Taper		
Hand.....	\$ 19.19	5.59
Tool.....	\$ 19.54	5.59
Painters:		
Brush and Roller.....	\$ 18.49	5.59
Spray.....	\$ 19.49	5.59
PAPERHANGER.....	\$ 19.19	5.59
-----		
PAIN0930-001 07/01/2009		
	Rates	Fringes
GLAZIER.....	\$ 27.95	7.10
-----		
PLAS0577-001 05/01/2010		
	Rates	Fringes
Cement Mason/Concrete Finisher...	\$ 24.60	10.10
-----		
PLUM0003-001 06/01/2010		
	Rates	Fringes
PLUMBER		
(Excluding HVAC work).....	\$ 33.37	10.35
-----		
PLUM0208-001 06/01/2010		
	Rates	Fringes
PIPEFITTER		
(Including HVAC pipe).....	\$ 33.30	10.52
-----		
SFCO0669-001 04/01/2010		
	Rates	Fringes
SPRINKLER FITTER.....	\$ 32.76	16.85
-----		
SHEE0009-001 07/01/2010		
	Rates	Fringes
Sheet metal worker		
(Includes HVAC duct and		
installation of HVAC		
systems).....	\$ 32.16	11.71
-----		
SUCO2001-011 12/20/2001		

	Rates	Fringes
Carpenters:		
All Other Work.....	\$ 16.12	2.84
Ironworkers:		
Reinforcing.....	\$ 18.49	3.87
Laborers:		
Brick Finisher/Tender.....	\$ 12.78	1.41
Common.....	\$ 10.62	2.09
Power equipment operators:		
Mechanic.....	\$ 18.48	

-----

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

=====

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

-----

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

-----

#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the

Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====  
END OF GENERAL DECISION

**Career Service Authority-Supplemental to the Davis-Bacon Building rates**  
**(Specific to the Denver projects)**  
**(Supp #85, Date: 10-15-10)**

(The following rates are from the Fed Davis-Bacon Build-Mod No. 8, 11/09/01 to fill in for missing rates from subsequent Build Construction Schedules)

	<u>Rates</u>	<u>Fringes</u>
• Boilermakers	21.34	11.04
• Power Equip Operator (Local #9)		
Concrete Mixers:		
Less than 1 yd.	19.22	5.17
1 yd. And over	19.37	5.17
Drillers	19.22	5.17
Loaders over 6 cu yd	19.37	5.17
Oilers	18.52	5.17
• Soft Floor Layers	15.70	5.19
• Ironworkers (Ornamental) use current Structural rate published by the Federal Davis-Bacon rates issued by CSA.		
• Laborers:		
Concrete Saw	13.89	-
• Plasters	16.10	-
• Plaster Tenders	10.79	-
• Power Equip Operator:		
Backhoe	13.84	2.96
Loader up to and incl 6 cu Yd	14.15	3.03
Motor Grader	14.48	3.49
Roller	14.59	-
• Truck Drivers:		
Dumps:		
6 to 14 cu yds	13.05	3.49
15 to 29 cu yds	13.12	3.49
Flatbed	14.71	2.94
Semi	13.85	-
• To determine the Tile Setters-Marble Mason-Terrazzo mechanic rates—Use Davis Bacon-Building rates adopted by the Career Service Board.		
• To determine the Tile Finisher-Floor Grinder-Base Grinder—Use current Career Service Prevailing Wage Schedules.		
• Caulkers—Receive rate prescribed for craft performing operation to which caulking is incidental .i.e. glazier, painter, brick layer, cement mason.		
• Use the “Carpenters—All Other Work” rates published by the federal Davis Bacon rates for batt insulation, pre-stress concrete and tilt up concrete walls, Roofers (including foundation waterproofing).		
• Use the “Laborer—Common”, rates published by the federal Davis Bacon rates for General Housekeeping, Final Cleanup and Fence Installer.		

# CITY AND COUNTY OF DENVER

STATE OF COLORADO



## TECHNICAL SPECIFICATIONS

**Contract No. 201100583**  
**Formerly (CE00767)**

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**CHERRY CREEK TRANSFER STATION**  
**ADDITIONS**

**December 7, 2010**

# **PROJECT MANUAL**

November 5, 2010

## **CITY AND COUNTY OF DENVER CHERRY CREEK TRANSFER STATION**

Project Number: CE00767



### **DRA | ARCHITECTURE, LLC**

455 Sherman Street, Suite 100

Denver, Colorado 80203

T:303-575-6800

FAX:303-454-9845

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**CITY & COUNTY OF DENVER  
CHERRY CREEK TRANSFER STATION**

**PROJECT ROSTER**

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**OWNER** *City & County of Denver  
Department of Public Works  
201 W. Colfax, Dept 507  
Denver, Colorado 80202*

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**CITY PROJECT  
MANAGER** *Capital Projects  
Management  
201 West Colfax Ave,  
Dept 507  
Denver, CO 80202* *Robert Alson  
720-913-8821  
robert.alson@ci.denver.co.us*

---

**ARCHITECT** *DRA Architecture LLC  
455 Sherman Street,  
Suite 100  
Denver, Colorado 80203* *Dennis Reseutek  
303-575-6800  
303-454-9845 (Fax)  
dreseutek@reseutek.com*

---

**CONSULTANTS**

**Civil Engineer** *Richard Weingardt  
Consultants  
9725 East Hampden Ave  
Suite 200  
Denver, Colorado 80231* *David Hargrove  
303/671-7033  
303-671-7379 (Fax)*

**Structural  
Engineer** *Richard Weingardt  
Consultants  
9725 East Hampden Ave  
Suite 200  
Denver, Colorado 80231* *Tom Fast  
303/671-7033  
303-671-7379 (Fax)*

**Mechanical  
Engineer** *Scanlon Szynskie Group,  
Inc  
3045 South Parker Road,  
Suite 225  
Aurora, Colorado  
80014-2904* *Matt Bylsma  
303-696-2602  
303-696-0812 (Fax)*

**Electrical  
Engineer** *M.E.Group Inc.  
707 17<sup>th</sup> Street  
Suite 300  
Denver, Colorado 80202* *Scott Payne / John Lang  
303-382-1920  
303-382-1930 (Fax)*

## **SECTION 01100 SUMMARY OF WORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and other Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 114, GC301, GC 701, GC804, GC 1401, GC 1904.
- C. 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.

#### **1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- A. Project Identification: Project consists of the remodeling and expansion of two separate facilities at the City & County of Denver Cherry Creek Transfer Facility.
  - 1. Projection Identification: Cherry Creek Transfer Station Fleet Maintenance Garage and Trash Transfer Station  
Project Contract Number: CE 00767
  - 2. Project Location: 7301 East Jewell Avenue, Denver, Colorado, 80231
  - 3. Owner: City & County of Denver, Webb Building, 201 West Colfax Avenue, Denver, Colorado 80202.
  - 4. City's Project Manager:  
Robert Alson, P.E.  
Denver Public Works  
Capital Projects Management  
201 West Colfax Ave, Dept 507  
Denver, CO 80202  
720-913-8821  
robert.alsen@ci.denver.co.us
- B. Architect: Bid Issue Documents were prepared for Project by:  
DRA Architecture LLC  
455 Sherman Street, Suite 100  
Denver, Colorado 80203.  
303-575-6800

- C. The Work consists of the following:
1. Base Project - Fleet Maintenance Garage Addition
  2. Add Alternate No.1 - Provide and Install Vehicle Wash Equipment at Fleet Maintenance Garage Addition.
  3. Add Alternate No.2 - Deleted
  4. Add Alternate No.3 - Add Remodeling of Space at South End of Fleet Maintenance Garage Building.
  5. Add Alternate No.4 - Add Construction of Trash Transfer Building in its entirety

### **1.3 TYPE OF CONTRACT**

- A. Project will be constructed under a single prime contract for the Base Project or under a single prime contract for both the Base Project plus approved Add Alternates.

### **1.4 WORK UNDER OTHER CONTRACTS**

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
1. Miscellaneous Fleet Maintenance Equipment: A separate contract will be awarded for the installation of miscellaneous fleet maintenance equipment.
  2. Miscellaneous Trash Transfer Equipment: A separate contract will be awarded for the installation of miscellaneous trash transfer equipment.
  3. Removal and relocation of Trash Transfer Scale House: The City will be responsible for removal and relocation of the Scale House on a concrete slab provided under this contract.
- C. Future Work: Owner may award separate contract(s) for the following additional work to be performed at site:
1. Site grading and drainage.

### **1.5 SITE CONDITIONS**

- A. The Contractor acknowledges satisfaction as to the nature and location of the Work, all of the general and local conditions, particularly those bearing upon availability of transportation, access to the site, disposal, handling

and storage of materials, availability of labor, water, power, roads, and uncertainties of weather, or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during work, and all other matters that can in any way affect the work or the cost thereof under this contract.

- B. The Contractor further acknowledges, by submission of a bid and on each change in work proposal, satisfaction as to the character, quality and quantity of all surface and subsurface materials and all features on top of the surface or at worksites that would be encountered from his inspection of the site and from reviewing available records of exploratory work furnished by the City. Failure by the Contractor to become acquainted with the physical conditions of the sites and all the available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of performing the Work.
- C. The Contractor warrants that as a result of examination and investigation of all the aforesaid data and the site, that the Contractor can perform the Work in a good and workmanlike manner and to the satisfaction of the City. The City assumes no responsibility for any representations made by any of its officers or agents during or prior to the execution of this contract unless such representation is expressly stated in the contract.

## **1.6 USE OF PREMISES**

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits. Each Contractor's use of premises is limited shall be limited and coordinated by Owner
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. Owner Occupancy: Allow for Owner occupancy of Project site.
- D. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
  - 1. Schedule deliveries to minimize use of driveways and entrances.
  - 2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- E. Use of Existing Buildings: Maintain existing buildings in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect buildings and their occupants during construction period.

## **1.7 OWNER'S OCCUPANCY REQUIREMENTS**

- A. Full Owner Occupancy: Owner will occupy or partially occupy the site and existing buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.
- 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 permission from Owner.
- C. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

## **1.8 WORK RESTRICTIONS**

- A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.

## **1.9 SPECIFICATION FORMATS AND CONVENTIONS**

- A. Specification Format: The Specifications are organized into Divisions and Sections using the CSI/CSC's "MasterFormat" numbering system.
  - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
  - 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be

interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
  - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

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

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

END OF SECTION 01100

## SECTION 01230 ALTERNATES

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for alternate bid prices.

#### 1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that will be added to the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum. All alternates are additive.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

#### 3.1 SCHEDULE OF ALTERNATES

- A. **Additive Alternate No. 1:** ADD provision and installation of Vehicle Wash Equipment at Fleet Maintenance Garage Addition.
  - 1. Add all Vehicle Wash Equipment as shown on Sheets A1.2, A4.1, A4.2, A6.1, M1.2, and P1.2.

2. Truck Wash Equipment is specified in Section 111126 "Vehicle Washing Equipment."
- B. **Additive Alternate No. 2:** Not Used.
- C. **Additive Alternate No. 3:** ADD Remodeling of South End of Fleet Maintenance Building.
1. Base Bid includes leaving the south end of the Fleet Maintenance Building in its present condition. No demolition, new general construction, mechanical construction, plumbing construction or electrical construction is required under the Base Bid.
  2. Add Alternate work required is remodeling of this area as presently shown on the drawings.
  3. Specifications for the work of this alternate are noted in the specifications.
- D. **Additive Alternate No. 4:** ADD Construction of Trash Transfer Building in its entirety.
1. Add construction of Trash Transfer Building as shown on separate bid Package "Trash Transfer Building Addition".
  2. Specifications for this construction are contained in the Project Specification Manual.

END OF SECTION 01230

## **SECTION 01310 PROJECT MANAGEMENT AND COORDINATION**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 306, GC 603, GC 909, GC 702, GC1103, GC 1202.

#### **1.2 SUMMARY**

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General project coordination procedures.
  - 2. Conservation
  - 3. Project meetings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Section 01770 "Closeout Procedures" for coordinating Contract closeout.

#### **1.3 COORDINATION**

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. If necessary, prepare memorandum for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's Construction Schedule.
  - 2. Preparation of the Schedule of Values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Pre-installation conferences.
  - 7. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

#### **1.4 SUBMITTALS**

- A. Coordination Drawings: Prepare Coordination Drawings to maximum utilization of space for efficient installation of different components and for installation of products and materials fabricated by separate entities.
  - 1. Indicate relationship of components shown on separate Shop Drawings.
  - 2. Indicate required installation sequences.
  - 3. Refer to Section 15010 "Basic Mechanical Requirements" and Section 16010 "Basic Electrical Requirements" for specific Coordination Drawing requirements for mechanical and electrical installation.
- B. Staff Names: Within fifteen (15) days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

## 1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three (3) days of the meeting.
- B. Pre-construction Conference: Scheduled and conducted by Contractor.
  1. Attendees: Authorized representatives of Owner, Architect, Contractor and its superintendent shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing.
    - d. Designation of responsible personnel.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for processing Applications for Payment.
    - g. Distribution of the Contract Documents.
    - h. Submittal procedures.
    - i. Preparation of Record Documents.
    - j. Use of the premises.
    - k. Responsibility for temporary facilities and controls.
    - l. Parking availability.
    - m. Office, work, and storage areas.
    - n. Equipment deliveries and priorities.
    - o. First aid.
    - p. Security.
    - q. Progress cleaning.
    - r. Working hours.
  3. Minutes: By Contractor: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned within three (3) days of the meeting.

- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparation for the particular activity under consideration.
  3. Minutes: Record significant conference discussions, agreements, and disagreements by Contractor's Project Manager.
  4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Contractor shall conduct progress meetings at weekly intervals.
1. Attendees: In addition to representatives of City, Architect, Contractor, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on-time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Review present and future needs of each entity present, including the following:
      - (1) Interface requirements.
      - (2) Sequence of operations.
      - (3) Status of submittals.
      - (4) Deliveries.

- (5) Off-site fabrication.
  - (6) Access.
  - (7) Site utilization.
  - (8) Temporary facilities and controls.
  - (9) Work hours.
  - (10) Hazards and risks.
  - (11) Progress cleaning.
  - (12) Quality and work standards.
  - (13) Change Orders.
  - (14) Documentation of information for payment requests.
3. Reporting: Contractor shall distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- a. Schedule Updating: Contractor shall revise Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION 01310

## **SECTION 01320 CONSTRUCTION PROGRESS DOCUMENTATION**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999 and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 306, GC309, GC 905.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Preliminary Construction Schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Submittals Schedule.
  - 4. Special Reports.
- B. Related Sections include the following:
  - 1. Section 01310 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
  - 2. Section 01330 "Submittal Procedures" for submitting schedules and reports.
  - 3. Section 01400 "Quality Control" for submitting a schedule of tests and inspections.
  - 4. Section 01770 "Closeout Procedures" for submitting Project Record Documents at Project closeout.

#### **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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  2. Predecessor activity is an activity that must be completed before a given activity can be started.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor.
  2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
  3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

#### **1.4 SUBMITTALS**

- A. Submittals Schedule: Submit an electronic copy of the schedule. Include and arrange the following information in a tabular format report:
1. Scheduled date for first submittal.
  2. Specification Section number and title.
  3. Submittal category (action or informational).

4. Name of subcontractor.
  5. Description of the work covered.
  6. Scheduled date for Architect's final release or approval.
- B. Preliminary Construction Schedule: Submit an electronic copy.
- C. Special Reports: Submit electronic fragments for changes to the schedule due to change orders along with a narrative explaining the fragment.
- D. Schedule Updates: Submit electronic copy of schedule and a narrative detailing the progress since the last update.

## **1.5 QUALITY ASSURANCE**

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01310 "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
  2. Verify availability of qualified personnel needed to develop and update schedule.
  3. Discuss constraints, including work stages and interim milestones.
  4. Review delivery dates for Owner-furnished products.
  5. Review schedule for work of Owner's separate contracts.
  6. Review time required for review of submittals and resubmittals.
  7. Review requirements for tests and inspections by independent testing and inspecting agencies.
  8. Review time required for completion and startup procedures.
  9. Review and finalize list of construction activities to be included in schedule.
  10. Review submittal requirements and procedures.
  11. Review procedures for updating schedule.

## **1.6 COORDINATION**

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from parties involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## **PART 2 PRODUCTS**

### **2.1 SUBMITTALS SCHEDULE**

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
  - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
  - 2. Link submittal items from submittal schedule to work activities that use those items in the construction schedule.
  - 3. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first sixty (60) days of construction. List those required to maintain orderly progress of the work and those required early because of long lead time for manufacture or fabrication.
  - 4. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

### **2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL**

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
  - 1. Contract completion date (equal to "Must Finish By" date) shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order. The early finish date of the

schedule may vary while the "Must Finish By" date will only be changed by change order.

- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. The schedule shall summarize to the contractor's approved Schedule of Values.
  2. Activity Duration: Define activities so no activity is longer than twenty (20) days, unless specifically allowed by Architect.
  3. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than sixty (60) days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  4. Submittal Review Time: Include review and resubmittal times indicated in Section 01330 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  5. Startup and Testing Time: Include not less than seven (7) days for startup and testing.
  6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: 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. Contract Completion Date: "Must Finish By."
  2. Phasing: Arrange list of activities on schedule by phase.
  3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01100 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01100 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  5. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Limitations of continued occupancies.

- b. Uninterruptible services.
  - c. Seasonal variations.
  - d. Environmental control.
6. Work Stages: Indicate important stages of construction for each major portion of the work, including, but not limited to, the following:
- a. Subcontract awards.
  - b. Submittals.
  - c. Purchases.
  - d. Fabrication.
  - e. Sample testing.
  - f. Deliveries.
  - g. Installation.
  - h. Tests and inspections.
  - i. Startup and placement into final use and operation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

### **2.3 PRELIMINARY CONSTRUCTION SCHEDULE**

- A. Bar-Chart Schedule: Submit preliminary electronic construction schedule within ten (10) days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Outline significant construction activities for first sixty (60) days of construction. Include skeleton diagram for the remainder of the Work.

### **2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE**

- A. Electronic Schedule: Submit a comprehensive, fully developed Contractor's Construction Schedule within thirty (30) days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule including updating and feedback that was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Link all activities using logical tiles and constrain activities as necessary with no more than 10 percent of the activities being constrained.

### **2.5 REPORTS**

- A. Daily Construction Reports: Prepare a daily construction report, recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. High and low temperatures and general weather conditions.
  5. List of activities that CPM schedule shows for the current day. Indicate work in progress on that day with a checkmark.
  6. Accidents.
  7. Meetings and significant decisions.
  8. Unusual events (refer to special reports).
  9. Stoppages, delays, shortages, and losses.
  10. Meter readings and similar recordings.
  11. Emergency procedures.
  12. Orders and requests of authorities having jurisdiction.
  13. Change Orders received and implemented.
  14. Construction Change Directives received.
  15. Services connected and disconnected.
  16. Equipment or system tests and startups.
  17. Partial Completions and occupancies.
  18. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## **PART 3 EXECUTION**

### **3.1 CONSTRUCTION PHOTOGRAPHS**

- A. Photographic Film: Medium-format, 2-1/4 inches by 2-3/4 inches. Digital photos at Contractor's option.
- B. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken.
- C. Preconstruction Photographs: Before starting construction, take four (4) color photographs of Project site and surrounding properties from different vantage points, as directed by Architect. Show existing conditions adjacent to property.
- D. Periodic Construction Photographs: Take four (4) color photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.
  - 1. Field Office Prints: Retain one (1) set of prints of periodic photographs in field office at Project site, available at all times for reference. Identify photographs the same as for those submitted to Architect and Project Manager.
- E. Final Completion Construction Photographs: Take eight (8) color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.

END OF SECTION 01320

## **SECTION 01330 SUBMITTAL PROCEDURES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC309, GC 405.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.
- B. Related Sections include the following:
  - 1. Section 01770 "Closeout Procedures" for submitting warranties, Project Record Documents, and operation and maintenance manuals.

#### **1.3 DEFINITIONS**

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

### **PART 2 PRODUCTS**

#### **2.1 ELECTRONIC SUBMITTALS**

- A. All submittals shall be delivered to the Project Manger and Designer in electronic format.
  - 1. Acceptable electronic formats:
    - a. Adobe Acrobat 8.0 or newer. All files shall be fully compatible with Adobe Acrobat 8.0. File shall have no security and bookmark every applicable submittal.
  - 2. Formats are acceptable only with written permission of the project manager or required by individual spec sections:

- a. Microsoft Office 2003 (2007 preferred) or newer. All files shall be fully compatible with Microsoft Office 2003.
  - b. AutoDesk AutoCAD 2007 or newer. All files shall be fully compatible with AutoDesk AutoCAD 2007.
    - (1) AutoCAD files shall be self contained with no external x-references.
  - c. Other files pre-approved by the Project Manager.
3. Electronic file names: Each electronic document shall have a unique file name. File name convention shall be as follows unless otherwise agreed to by Project Manager: - AAA-BBBBB-CCC-RZ
- a. AAA = sequential submittal number starting at 001.
  - b.BBBBB = specification section containing submittal requirements
  - c. CCC = sequential specification submittal number starting at 001.
  - d. RZ = sequential revision number. RZ not required on initial submittals.
  - e. Example A: "005-01370-002", five submittals have been logged overall with two submittals made to specification section 01370.
  - f. Example B: "009-01370-002-R3", nine submittals made overall and three revisions to submittal 01370-002.

## 2.2 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 City or the Designer of Record may indicate the action taken.

- C. Make submissions sufficiently in advance so that the Designer and City review may be completed before any material procurement or Work represented by those submittals is scheduled to be performed.
- D. Allow a minimum cycle of 10 working days for review of each submittal.
- E. The Contractor shall at the time of submission describe variations from the contract documents in writing, separate from the submittal document. If the 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.
- F. Changes in accepted submittal documents will not be permitted unless those changes have been accepted, in writing, by the City.

### **2.3 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.

### **2.4 SAMPLES**

- A. Samples: Prepare physical units of materials or products, including the following:
  - 1. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - 2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - 3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

- a. Generic description of Sample.
  - b. Product name or name of manufacturer.
  - c. Sample source.
4. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
- a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of the variations.
5. Number of Samples for Initial Selection: Submit one (1) full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Number of Samples for Verification: Submit three (3) sets of Samples. Architect will retain two (2) Sample sets; remainder will be returned.
- a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
7. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
- a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

## **2.5 INFORMATIONAL SUBMITTALS**

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Architect will not return copies.
  2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

- B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- I. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer

## **2.6 TIMING**

- A. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.

1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow twenty-one (21) days for initial review of each submittal.
3. If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Allow fifteen (15) days for processing each resubmittal.
5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

### **PART 3 EXECUTION**

#### **3.1 CONTRACTOR'S REVIEW**

- A. The Contractor shall review submittal documents, stamp and sign as reviewed and approved as complying with contract documents prior to submission to the City.

#### **3.2 ARCHITECT'S REVIEW**

- A. Submittal documents will be reviewed by the Architect and the City's Project Manager for conformance to requirements of the contract drawings and specifications. Review of a separate item will not constitute review of an assembly in which the item functions. The Architect or the Project Manager will withhold approval of submittals that depend on other submittals not yet submitted. Review and acceptance will not relieve the Contractor from his 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 Architect and the 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. A - ACCEPTED is an approval, and means that the illustration and description appears to conform to the respective requirements of the contract documents.
  2. B - ACCEPTED AS NOTED is an approval, and means that the illustration and description will conform to the respective requirements

of the contract documents after changes in recognition of the reviewer's comments. Submittals so marked need not be resubmitted.

3. C - REVISE AND RESUBMIT means that the submittal is unacceptable and must be revised and resubmitted.
4. E - NOT ACCEPTED means that the submittal is not approved and that a new submittal in accordance with the contract documents shall be made.
5. F - RECEIPT ACKNOWLEDGED, means an item is received by the Architect but no review was made. This mark is for use in resubmitting items that were previously Accepted as Noted and the Contractor has incorporated the notes and wants the Architect to have the same material that the Contractor's field staff is using.

### **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 Architect'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 Architect's review and acceptance of submittals containing variations unless the Architect expressly approves the deviation in writing, in which the Architect describes the variation.
- D. The Contractor shall maintain a file of all approved submittal documents at the worksite. The complete file of approved submittal documents shall be turned over to the City with the as-built documents at the end of the job.
- E. Schedule impact due to resubmittal requirements is the responsibility of the Contractor.

END OF SECTION 01330

## **SECTION 01400 QUALITY CONTROL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- C. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
- D. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
- E. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### **1.3 REQUIREMENTS INCLUDED**

- A. Testing required of Contractors.
- B. Contractor's quality control systems.
- C. Manufacturer's field services.
- D. Independent Testing Agency services.

#### **1.4 TESTING - GENERAL**

- A. The term "testing" as used herein is defined as testing and/or inspection.

- B. The Contractor shall provide such equipment and facilities as the Testing Agency may require for conducting field tests and for collecting and forwarding samples. The Contractor shall not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment found to be acceptable. Any product which becomes unfit for use after acceptance shall not be incorporated into the work.
- C. All materials or equipment, proposed to be used, may be tested at any time during their preparation or use. The Contractor shall furnish the required samples without charge and shall coordinate testing with the Owner's Representative and/or Testing Agency to allow sufficient time for testing before placing orders or starting work. Products may be tested either prior to shipment or after being received at the jobsite.
- D. Tests shall be made by an accredited testing agency with a minimum of five (5) years experience in the specific type of testing to be performed. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the American Society for Testing Materials (ASTM).
- E. Where additional or specific information concerning testing methods, samples sizes, etc., is required, such information is included under this section of the Specifications.

## **1.5 TESTING REQUIRED OF CONTRACTORS**

- A. The following testing shall be performed at the expense of the Contractor installing the material being tested:
  - 1. Material or Method Substitution: Any tests of basic material, fabrication equipment or method offered as a substitute for specified items or methods on which a test may be required in order to prove its compliance with the specifications.
  - 2. Product Performance Verification: The Supplier of products specified based on performance criteria shall, at the request of the Architect or Structural Engineer, inspect the installed product and certify conformance of the product to specified criteria under the installed conditions.
  - 3. Corrective measures resulting from any test that fails shall be paid for by the installing contractor and shall be subject to the following conditions:
    - a. Quantity and nature of additional testing, if required, will be determined by the responsible consultant.
    - b. All additional tests shall be taken in the presence of the responsible consultant or his representative.

- c. Proof of noncompliance will make the installing contractor liable for any corrective action which the responsible consultant feels is prudent, including complete removal and replacement of defective material.
- d. Nothing contained herein is intended to imply that the installing contractor does not have the right to have tests performed on any material at any time for his own information and job control so long as the Owner does not assume responsibility for costs or for giving them consideration when appraising quality of materials.

## **1.6 TEST REPORTS**

- A. Reports of all tests shall be distributed by the testing agency as follows:
  - 1. One (1) copy - General Contractor's Project Manager
  - 2. One (1) copy - General Contractor's Field Superintendent
  - 3. One (1) copy - Applicable supplier or subcontractor
  - 4. One (1) copy - Owner (Construction Representative)
  - 5. One (1) copy - Applicable Engineer
  - 6. One (1) copy - Architect
  - 7. Other copies - as directed

## **1.7 CONTRACTOR'S QUALITY CONTROL SYSTEM**

- A. General: The General Contractor shall establish a quality control system and shall perform sufficient inspection and tests of all items of work, including that of his subcontractors, to ensure conformance to the Contract Documents for materials, workmanship, construction, finish, functional performance and identification. Contractor's quality control system is the means by which he assures himself that his construction complies with the requirements of the Contract Documents. Controls shall be adequate to cover all construction operations.
- B. Pre-Installation Conference:
  - 1. Contractor shall schedule and conduct a pre-installation conference to review the detailed quality control and construction requirements for the materials and/or systems listed below or as called for in other specification sections, not less than ten (10) working days prior to commencement of the work:
    - a. Earthwork.

- b. Cast-in-place concrete.
  2. The Contractor shall require responsible representatives of each party concerned with that portion of the work to attend the conference, including but not limited to the following:
    - a. Contractor's superintendent.
    - b. Materials supplier(s) or fabricator.
    - c. Installation subcontractor(s).
    - d. Agency responsible for Contractor-furnished testing.
  3. The Architect and his structural consultants and the Testing Agency will be present and shall be notified by the Contractor at least five (5) days prior to the scheduled date of such conference.
  4. Minutes of the conference shall be recorded by the Contractor and shall be distributed by him in typed or printed form to each party in attendance within five (5) days of the meeting. One (1) copy of these minutes shall also be transmitted to the Owner's representative for information.
- C. Records: Contractor shall maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Architect, responsible Engineer or Testing Agency, and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.), proposed or directed remedial action, and corrective action taken. Contractor shall document inspections and tests as required by each section of the Specifications.

## **1.8 MANUFACTURER'S FIELD SERVICES**

- A. When specified in respective Specification sections, Contractor shall require supplier or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, testing, and to make appropriate recommendations.
- B. Manufacturer's representative shall submit written report to the Architect and responsible Engineer listing observations and recommendations.
  1. Field Report: Received in Architects office next business day following each days visit.

## **1.9 INDEPENDENT TESTING AGENCY SERVICES**

- A. General: The Owner will employ and pay for the services of an independent Testing Agency to perform the following inspections, tests and other services.

Services shall be performed in accordance with requirements of governing authorities and with specified standards.

1. Contractor shall cooperate with Testing Agency personnel and shall furnish inspectors a full set of shop drawings stamped by the reviewing engineer, tools, samples of materials, design mixes, equipment, and assistance as requested.
2. Contractor shall provide and maintain, for the sole use of the Testing Agency, adequate facilities for the safe storage and proper curing of concrete test cylinders on the project site for the first twenty-four (24) hours after casting as required by ASTM C31, Method of Making and Curing Concrete Test Specimens in the Field.
3. Contractor shall notify Testing Agency at least ten (10) working days in advance of any qualification testing for welding required herein.
4. Contractor shall notify Testing Agency at least twenty-four (24) hours prior to expected time for operations requiring testing or inspection services.
5. Contractor shall make arrangements with the Testing Agency and pay for additional samples and tests made for the Contractor's convenience or for retesting of failed samples.
6. Retention of an independent Testing Agency shall in no way relieve the Contractor of responsibility for performing all work in accordance with contract requirements.
7. The Testing Agency inspector shall familiarize himself with all applicable portions of the Contract Documents pertaining to his area of investigation prior to performing his services.

**B. Testing Agency Qualifications**

1. For each type of inspection and testing service to be performed, the Testing Agency shall submit certification, signed and sealed by the Agency's professional engineer, of compliance with all applicable requirements of the following:
  - a. ASTM E329, "Standard Recommended Practice for Inspection Agencies for Concrete, Steel and Bituminous Materials Used in Construction."
  - b. "Recommended Requirements for Independent Laboratory Qualifications" published by the American Council of Independent Laboratories.

2. Furnish evidence, satisfactory to the Architect, that all equipment to be used has been calibrated in accordance with applicable ASTM standards within the last year and is in proper working order.
3. Testing and inspection services shall be performed only by trained and experienced technicians currently qualified for the work they are to perform. Documentation of such training and experience shall be submitted to the Owner, Architect and Structural Engineer upon request. Weld inspection shall be done by certified weld inspectors only.

C. Soil Material and Soil Compaction

1. Compacted fill, subgrades under compacted fill or paved areas and backfill at all utility trenches (includes those by utilities companies) shall be tested as follows:
  - a. The top 6 inches of subgrade resulting from excavation shall have the maximum density at optimum moisture specified under Section 02200 "Earthwork." Make at least one (1) field density test of the subgrade for every 5,000 square feet of area, but in no case less than three (3) tests.
  - b. In each compacted fill layer, make one (1) field density test for every overlying 2,000 square feet of area, but in no case less than three (3) tests. Perform field density tests in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922.
  - c. The relative density of a cohesionless, free-draining soil, expressed as a percentage, is defined as its state of compactness with respect to the most loose and most compact states at which it can be placed by laboratory procedures. The relative density will be based on the following formula, wherein the maximum density is the highest dry unit weight of the soil, minimum density is lowest dry unit weight of the soil, and in-place density is the dry unit weight of the soil in place:

Relative Density (%) =

$$\frac{\text{Max. Den.} \times (\text{in-place den.} - \text{min. den.}) \times 100}{\text{In-place den.} \times (\text{max. den.} - \text{min. den.})}$$

D. Concrete Work:

1. Concrete inspection and testing will be made in accordance with building code requirements, and Contract Documents, and will include the following:
  - a. Testing concrete for strength, slump, air content, temperature, and unit weight.

- b. Making and testing concrete cylinders, including furnishing cylinder containers for specimens.
- c. Transporting and storing of all specimens involved in testing and inspection. Test cylinders are to be transported to laboratory not later than twenty-four (24) hours after casting, nor earlier than sixteen (16) hours after casting.
- d. Inspection of mixing and placing of concrete at the site, including recording of: amount and location of concrete placement, truck number and amount of water added to each load of concrete tested, time of transit, time mixed on job, time placement was completed, method of placing concrete, and any other pertinent information.

2. Test Specimens:

- a. The Testing Laboratory will take specimens of each class of concrete from different locations on the job as follows: One set of four cylinders for each truckload of caisson concrete or one set for each caisson requiring more than one truckload of concrete. At least one set of four cylinders for each 50 cubic yards or fraction thereof of all other concrete, but not less than one set for any one (1) day's operations. Each concrete truckload shall be checked for proper slump.
- b. For concrete placed by pumping, test specimens and concrete used for determination of slump, air content, and weight are to be taken at the point of placement of concrete into the forms.
- c. For concrete placed in loading ramp and sidewalks, test specimens and concrete used for determination of slump, air content, and weight are to be taken at the point of placement of concrete into the forms. Take at least one (1) set of four (4) cylinders for each 50 linear feet of loading ramp and sidewalk or fraction thereof.
- d. Samples will be obtained in accordance with ASTM C 172.
- e. Making, curing and subsequent handling of test cylinders, except as modified herein, shall be in accordance with ASTM C 31. Testing shall be in accordance with ASTM C 39.
- f. The cylinders shall be placed in laboratory storage under moist curing conditions at approximately 70° F within twenty-four (24) hours after molding, and maintained therein until tested. Tests will be as follows:
  - (1) One cylinder shall be tested at seven (7) days for information.

- (2) Two cylinders shall be tested at twenty-eight (28) days for acceptance. The acceptance test results shall be the average strength of these two cylinders.
    - (3) One cylinder shall be tested at forty-five (45) days for information.
3. Test Reports: Reports of cylinder tests shall be submitted as specified herein within five (5) days of laboratory testing. Test reports shall, as a minimum, include:
  - a. Project data including project name and address, concrete supplier, supplier's delivery ticket number and mix identification number, Testing Agency's test or cylinder identification number, and location of pour.
  - b. Results of field testing at time of sampling including date and time of sampling, amount of water added at site prior to sampling, ambient air temperature and concrete temperature, concrete slump and air content, concrete wet unit weight, time batched, and time placed.
  - c. Results of laboratory testing including date test specimens were transported to laboratory, date and age of concrete at time of testing, compressive strength of each cylinder tested, average compressive strength of tested cylinders, and specified design strength of concrete represented by the test.
4. Additional Testing: Contractor shall bear the cost of testing and inspection resulting as a consequence of the following:
  - a. Work not in compliance with the Contract Documents.
  - b. Testing requested by the Contractor or Subcontractor such as additional cylinders for early breaks, etc.
  - c. Testing to verify the adequacy of work done without prior notice, without proper supervision, or contrary to standard construction practice.
5. Reinforcing Steel Inspection: Concrete reinforcing shall be inspected prior to closing of concrete formwork or placing of concrete. Inspect all reinforcing for conformance with contract requirements. Submit written reports of all inspections as specified herein on a weekly basis. Such reports shall include a description of each area inspected, deficiencies noted, and corrective action undertaken to resolve such deficiencies. Deficiencies observed shall immediately be brought to the attention of the Contractor's Field Superintendent. In the event deficiencies are not

corrected, or if an interpretation of the contract documents is required, the Architect shall be immediately notified.

E. Structural Steel and Metal Fabrications:

1. The Testing Agency shall be responsible to inspect all field connections as specified herein. The Testing Agency may also conduct inspections at the fabricator's facility during steel fabrication.
2. For steel fabrication done in non-domestic (non-U.S.) fabrication facilities, inspections at the fabrication facility deemed necessary by the Testing Agency to verify compliance with AISC, AWS, and project specifications, shall be done at the expense of the General Contractor.
3. The Testing Agency's inspector will perform his duties in such a way that neither fabrication nor erection is unnecessarily delayed or impeded. In no case will the inspector recommend or prescribe the method of repair of a defect.
4. Shop and/or field inspection by the Testing Agency of fabricated and/or erected steel will be such as to assure that the work conforms to specified requirements and will include:
  - a. Inspection of welding as required herein.
  - b. Ascertainment of proper fit and alignment.
  - c. Ascertainment of proper installation and tensioning of bolts.
  - d. Ascertainment that Contractor's erection procedures adequately correct for distortion and shrinkage in field welded assemblies and connections.
5. Welding and Materials:
  - a. Inspection of welding by the Testing Agency will be such as to assure that the work conforms to specified requirements, and will include:
    - (1) Ascertainment that electrodes used for manual shielded metal-arc welding and the electrodes and flux used for submerged arc welding conform to the requirements of Section 05120 "Structural Steel."
    - (2) Ascertainment that the approved welding procedure and the approved welding sequence are followed without deviation unless specific approval for change is obtained from the Architect.

- (3) Ascertainment that the welding is performed only by welding operators and welders who are properly certified. The Testing Agency shall witness such qualification testing of welding operators and welders, as may be required.
  - (4) Ascertainment that the fit-up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements and the contract drawings, and that no specified welds are omitted or unspecified welds added without approval of the Architect.
- b. The Testing Agency shall test field welds as follows:
  - (1) All welds, including wall and shoring connections: 100 percent visual.
  - (2) All full or partial penetration groove welded connections: 100 percent ultrasonic.
  - (3) All other welds: 10 percent magnetic particle.
- c. Additional testing will be required of:
  - (1) If more than 10 percent of the tested welds are rejected, then an additional 10 percent of all such welds shall be tested using the same method. This 10 percent additional testing process shall be repeated until the rejection rate drops below one in 10.
  - (2) All cost of additional inspection required by this paragraph shall be borne by the Contractor.
- d. In addition, if defective welds are discovered, the remaining uninspected welds shall receive such ultrasonic or magnetic particle inspection as may be required by the Architect.
- e. The welding inspector will have the authority to reject welds. Such rejection may be based on visual inspection where in his opinion the weldment would not pass a more detailed investigation.
- f. Reports by the Testing Agency's inspector will contain, as a minimum, an adequate description of each weld tested, the identifying mark of the welder responsible for the weld, a critique of any defects noted by visual inspection or testing, and a statement regarding the acceptability of the weld tested, as judged by current A.W.S. standards. Reports shall be distributed as early as possible but not later than one (1) work week after the tests have been performed. The Architect shall be notified by phone if, in the judgment of the inspector, test results require immediate comment.
- g. Radiographic testing may be substituted for ultrasonic.

6. Bolted Connections: Visually inspect all bolted connections to ascertain that all bolts, nuts and required washers have been installed and are of proper type and that all surfaces have been brought into snug contact.
7. Tensioned High Strength Bolts:
  - a. Standard Bolts:
    - (1) Inspect the bolt tightness of 10 percent of the bolts (minimum of two), selected at random in each high strength bolted connection of structural steel framing on the project. If rejectable bolts are found in any connection, all the remaining bolts in that connection shall be inspected for tightness.
    - (2) Inspection procedure shall be in accordance with "Specification for Structural Joints Using ASTM A325 or A490 Bolts" approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (Research Council on Structural Connections).
  - b. Tension Control (Self-Indicating) Bolts:
    - (1) Inspect tightness of 10 percent (minimum of two) of the bolts, selected at random in each high strength bolted connection on the structural steel framing on the project in accordance with the procedure specified for standard bolts, first paragraph.
    - (2) Perform a visual inspection of all remaining high strength bolted connections to assure that all torque-off splines have been sheared.
    - (3) When splines are not sheared, the Testing Agency shall determine that proper bolt tension has been achieved by the application of a properly calibrated testing torque or the Contractor may, at his option, remove and replace all bolts with unsheared splines. All cost of additional inspection required by this paragraph shall be borne by the Contractor.

G. Steel Deck:

1. The Testing Agency will visually inspect all steel deck to observe that material is in acceptable condition and has been properly installed.
2. The Testing Agency shall visually inspect all deck welds prior to being covered by other work.

H. Drilled-In Inserts:

1. Self-Expanding Inserts: The Testing Agency shall inspect self-expanding, drilled-in inserts shown on the structural drawings as follows:

- a. Prior to installation, the Testing Agency shall determine that the installing contractor has the proper materials and equipment for drilling holes in the receiving surface of required diameter and length.
- b. All inserts shall be visually inspected after installation to ensure that they have been installed perpendicular to the receiving surface and to proper depth.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION 01400

## **SECTION 01500 TEMPORARY FACILITIES AND CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Addition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 325, GC326, GC 803.

#### **1.2 SUMMARY**

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
  - 2. Divisions 2 through 16 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
  - 3. Division 2 Section "Hot-Mix Asphalt Paving" for maintenance of asphalt paving for temporary roads and paved areas.

#### **1.3 CHARGES**

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, testing agencies and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### **1.4 QUALITY ASSURANCE**

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## **1.5 PROJECT CONDITIONS**

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch-OD corner and pull posts.

### **2.2 TEMPORARY FACILITIES**

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of 8 individuals. Provide electrical power service and 120-V ac duplex receptacles. Furnish room with conference table and chairs.
  - 3. Drinking water and private toilet.
  - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

### **2.3 EQUIPMENT**

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

- B. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Locate facilities as shown on Site Plan and as coordinated with City Project Manager.

### **3.2 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. Use of Owner's existing toilet facilities will not be permitted.
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install two telephone line(s) for each field office.
  - 1. Provide additional telephone lines for the following:

- a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
2. At each telephone, post a list of important telephone numbers.
  - a. Police and fire departments.
  - b. Ambulance service.
  - c. Contractor's home office.
  - d. Architect's office.
  - e. Engineers' offices.
  - f. Owner's office.
  - g. Principal subcontractors' field and home offices.
3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### **3.3 SUPPORT FACILITIES INSTALLATION**

- A. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations
  1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel as shown on Site Plan. Coordinate with City Project Manager.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.
- E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- F. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

### **3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that

minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
  - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- G. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
  - 1. Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
    - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
  - 2. Insulate partitions to provide noise protection to occupied areas.
  - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  - 4. Protect air-handling equipment.
  - 5. Weather strip openings.
  - 6. Provide walk-off mats at each entrance through temporary partition.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### **3.5 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 01500

## **SECTION 01600 PRODUCT REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 406

#### **1.2 SUMMARY**

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; Request for Approval to Bid, product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

#### **1.3 DEFINITIONS**

- A. Products: Items purchased 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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers

#### 1.4 SUBMITTALS

- A. Request for Approval to Bid: Submit two (2) copies of each request for consideration. Identify product and include all information requested on the form (following this section). The form "Request for Approval to Bid" shall accompany all requests and shall be filled out completely. Any request for approval to bid that are not accompanied by this form will not be reviewed.
  - 1. Documentation: Show compliance with specifications and the following as applicable:
    - a. Detailed comparison with products specified.
    - b. Product data including drawings and descriptions of products and fabrication and installation procedures.
    - c. List of similar installations for completed projects with project name and addresses of architects and owners.
    - d. Research/evaluation reports evidencing compliance with building code in effect for Project.
  - 2. Time: Request for Approval to Bid shall be received by Architect at least seven (7) working days prior to bid date. Late requests will not be reviewed.
  - 3. Products approved to bid will be listed in addendums.
- B. Substitution Requests: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. See General Contract Conditions, Article 406.
  - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner

and separate contractors, that will be necessary to accommodate proposed substitution.

- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - h. Research/evaluation reports evidencing compliance with building code in effect for Project.
  - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one (1) week of receipt of a request for substitution.

## **1.5 QUALITY ASSURANCE**

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be 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, Architect will determine which products shall be used.

## **PART 2 PRODUCTS**

### **2.1 PRODUCT OPTIONS**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that 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," Architect will make selection.
  5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
  - a. Substitutions may be considered.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  - a. Substitutions may be considered.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample.
  - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
9. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase,

select a product (and manufacturer) that complies with other specified requirements.

- a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
- b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

## **2.2 COMPARABLE PRODUCTS**

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
  1. Evidence that the proposed product does not require extensive 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.

## **PART 3 EXECUTION**

Not Used

END OF SECTION 01600

## **SECTION 01700 EXECUTION REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 318, GC324, GC 803, GC1801.

#### **1.2 SUMMARY**

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Sections include the following:
  - 1. Section 01310 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
  - 2. Section 01731 "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
  - 3. Section 01770 "Closeout Procedures" for submitting final work survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

### **1.3 SUBMITTALS**

- A. Qualification Data: For land surveyor or professional engineer 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.
- B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two (2) copies signed by land surveyor.
- D. Final Work Survey: Submit four (4) copies showing the Work performed and record survey data.

### **1.4 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in the State of Colorado and who is experienced in providing land-surveying services of the kind indicated.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, water-service piping, and underground electrical services.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.

- c. List of unacceptable installation tolerances.
- d. Recommended corrections.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  1. Notify Owner not less than two (2) days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without Owner's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### **3.3 CONSTRUCTION LAYOUT**

- A. Verification: Before proceeding to layout the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### **3.6 PROGRESS CLEANING**

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 80 °F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
  - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### **3.7 STARTING AND ADJUSTING**

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01400 "Quality Control."

### **3.8 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### **3.9 CORRECTION OF THE WORK**

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01731 "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

Cherry Creek Transfer Station  
CCD Contract Number: CE00767

November 5, 2010

## **SECTION 01731 CUTTING AND PATCHING**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 315.

#### **1.2 SUMMARY**

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Division 2 Section "Selective Demolition" for demolition of selected portions of the building.
  - 2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

#### **1.3 DEFINITIONS**

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

#### **1.4 SUBMITTALS**

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least ten (10) days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
6. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

## 1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  1. Primary operational systems and equipment.
  2. Fire-protection systems.
  3. Control systems.
  4. Communication systems.
  5. Mechanical systems piping and ducts.
  6. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch 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 that results in increased maintenance or decreased operational life or safety.
  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- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch 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, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
    - a. Precast concrete finishes.
    - b. Metal building panels.
    - c. Roof.
    - e. HVAC enclosures, cabinets, or covers.
- E. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

## **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.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually 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.

## **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.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of 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 Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

### **3.3 PERFORMANCE**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

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.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to 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/Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
  5. 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 Sections of these Specifications.
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.
  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 in a painted surface, apply primer and intermediate paint coats over the patch and apply final

paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

END OF SECTION 01731

## **SECTION 01770 CLOSEOUT PROCEDURES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 318, GC324, GC 803, GC1801.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Instruction of Owner's personnel.
  - 4. Final cleaning.

#### **1.3 SUBSTANTIAL COMPLETION**

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs,

damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Advise Owner of changeover in heat and other utilities.
  12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### **1.4 FINAL COMPLETION**

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit, to the Project Manager, certified copy of Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### **1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)**

- A. Preparation: Submit three (3) copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.d.Name of Contractor.
    - d. Page number.
- B. Contractor to furnish documentation to the Architect that the Contractor has completed their own punch-list items prior to the Owner/Architect inspection.

## **1.6 WARRANTIES**

- A. Submittal Time: Submit written warranties on request of Project Manager for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 EXECUTION**

### **3.1 DEMONSTRATION AND TRAINING**

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
  3. Schedule training with Owner's personnel, through Project Manager, with at least fourteen (14) days' advance notice.
  4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
  5. The training shall be video recorded and two (2) copies of final video shall be provided to the Owner.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
1. System design and operational philosophy.
  2. Review of documentation.
  3. Operations.
  4. Adjustments.
  5. Troubleshooting.
  6. Maintenance.
  7. Repair.

### **3.2 FINAL CLEANING**

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- i. Remove labels that are not permanent.
- j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
  - (1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- l. Replace parts subject to unusual operating conditions.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - p. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

## **SECTION 01781 PROJECT RECORD DOCUMENTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 323, GC 2003.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. Related Sections include the following:
  - 1. Division 1 Section "Closeout Procedures" for general closeout procedures.
  - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

#### **1.3 SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit two set of marked-up Record Prints.
    - a. Architect will return one set of prints with any comments or changes required to the Record Prints.
  - 2. Final Submittal: Submit one set of marked-up Record Prints.
- B. Record Specifications: Submit two copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

## **PART 2 - PRODUCTS**

### **2.1 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings at the site.
  1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Locations and depths of underground utilities.
    - d. Revisions to routing of piping and conduits.
    - e. Revisions to electrical circuitry.
    - f. Actual equipment locations.
    - g. Duct size and routing.
    - h. Locations of concealed internal utilities.
    - i. Changes made by Change Order or Change Directive.
    - j. Changes made following Architect's written orders.
    - k. Details not on the original Contract Drawings.
    - l. Field records for variable and concealed conditions.
    - m. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
6. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

## **2.2 RECORD SPECIFICATIONS**

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders and Record Drawings where applicable.

## **2.3 RECORD PRODUCT DATA**

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

## **2.4 MISCELLANEOUS RECORD SUBMITTALS**

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## **PART 3 - EXECUTION**

### **3.1 RECORDING AND MAINTENANCE**

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
  
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01781

## **SECTION 01782 OPERATION AND MAINTENANCE DATA**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. Reference Contract General Conditions GC 2003.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.
- B. Related Sections include the following:
  - 1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
  - 3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
  - 4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

#### **1.3 SUBMITTALS**

- A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.
- B. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 2 copies of each corrected manual within 15 days of receipt of Architect's comments.

## **1.4 COORDINATION**

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## **PART 2 - PRODUCTS**

### **2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### **2.2 MANUALS, GENERAL**

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name, address, and telephone number of Contractor.
  6. Name and address of Architect.
  7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
    - a. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
    - b. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## **2.3 EMERGENCY MANUALS**

- A. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- C. Emergency Procedures: Include the following, as applicable:
  1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## **2.4 OPERATION MANUALS**

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
  1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.

4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Engineering data and tests.
  8. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## **2.5 PRODUCT MAINTENANCE MANUAL**

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.

5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  1. Standard printed maintenance instructions and bulletins.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  4. Aligning, adjusting, and checking instructions.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  - G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
  - H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    1. Include procedures to follow and required notifications for warranty claims.

## **PART 3 - EXECUTION**

### **3.1 MANUAL PREPARATION**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- E. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  1. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- F. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- G. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."
- H. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

### **3.2 DEMONSTRATION AND TRAINING**

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Provide instructors experienced in operation and maintenance procedures.
  2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
  3. Schedule training with Owner's personnel, through Project Manager, with at least fourteen (14) days' advance notice.
  4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
  5. The training shall be video recorded and two (2) copies of final video shall be provided to the Owner.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
1. System design and operational philosophy.
  2. Review of documentation.
  3. Operations.
  4. Adjustments.

5. Troubleshooting.
6. Maintenance.
7. Repair.

END OF SECTION 01782

## **SECTION 02110 SITE CLEARING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Clearing and grubbing.
  - 2. Stripping and stockpiling topsoil.
  - 3. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

#### **1.3 DEFINITIONS**

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

#### **1.4 PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner.
- B. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

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

## **PART 3 - EXECUTION**

### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.2 CLEARING AND GRUBBING**

- A. Remove grass, and other vegetation to permit installation of new construction.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### **3.3 TOPSOIL STRIPPING**

- A. Remove grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile surplus topsoil to allow for respreading deeper topsoil.

### **3.4 SITE IMPROVEMENTS**

- A. Remove paving as indicated.

### **3.5 DISPOSAL**

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
  - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 02230

## **SECTION 02221 BUILDING DEMOLITION**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Demolition and removal of buildings and structures.
  - 2. Demolition and removal of site improvements adjacent to a building or structure to be demolished.
  - 3. Disconnecting, capping or sealing, and abandoning in place removing site utilities.
- B. Related Sections include the following:
  - 1. Division 1 Section "Summary" for use of the premises and phasing requirements.
  - 2. Division 1 Section "Alternates" for demolition at Fleet Maintenance Building and Trash Transfer Building.
  - 3. Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of building demolition.
  - 4. Division 15 Sections for demolishing or relocating site mechanical items.
  - 5. Division 16 Sections for demolishing or relocating site electrical items.

#### **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 recycled.
- B. 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 SUBMITTALS**

- A. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of adjacent buildings and partial use of premises.

#### **1.5 PROJECT CONDITIONS**

- A. Owner assumes no responsibility for buildings and structures to be demolished.

#### **1.6 COORDINATION**

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

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

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building demolition required.
- B. 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 Architect.

#### **3.2 PREPARATION**

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
  1. Owner will arrange to shut off indicated utilities when requested by Contractor.
  2. Refer to Division 15 and 16 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.

- B. 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.

### **3.3 PROTECTION**

- A. Existing Facilities: Protect building entries and other building facilities during demolition operations.
- B. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
- C. 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 Division 1 Section "Temporary Facilities and Controls."
  - 1. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 2. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  - 3. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
  - 4. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise from occupied portions of adjacent buildings.

### **3.4 DEMOLITION, GENERAL**

- A. General: Demolish indicated existing building elements as shown on Drawings. 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 adequate ventilation when using cutting torches.
  - 3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. 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.
- C. 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.

### **3.5 DEMOLITION**

- A. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
- D. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by Architect.
- E. Building Components: Remove doors and frames, windows, plumbing fixtures and light fixtures whole units, intact and undamaged.
- F. Remove existing flooring in areas to receive new flooring.
- G. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- H. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
- I. Cleanly cut and remove existing roof along with eave and gutter, as required to flush roof with wall.

### **3.6 REPAIRS**

- A. General: Promptly repair damage to adjacent construction caused by building 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.

### **3.7 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 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. Transport recyclable materials off Owner's property and legally dispose of them.
- B. Asphalt: Grind asphalt to maximum 4-inch size.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals. Pulverize concrete to maximum 1-1/2-inch size.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals. Temporary shore opening as required.
- E. Metals: Separate metals by type.
- F. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- G. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs.
- H. 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.
- I. Lighting Fixtures: Separate lamps by type and protect from breakage.
- J. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- K. Conduit: Reduce conduit to straight lengths and store by type and size.

### **3.8 DISPOSAL OF DEMOLISHED MATERIALS**

- A. 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.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### **3.9 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.

END OF SECTION 02221

## **SECTION 02300 EARTHWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Preparing subgrades for slabs-on-grade, walks, and pavements.
  - 2. Excavating and backfilling for buildings and structures.
  - 3. Drainage course for slabs-on-grade.
  - 4. Subbase and base course for asphalt and concrete paving.
  - 5. Excavating and backfilling for utility trenches.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Divisions 15 and 16 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

#### **1.3 DEFINITIONS**

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### **1.4 SUBMITTALS**

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
  - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
  - 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.

#### **1.5 QUALITY ASSURANCE**

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified hired by the Owner, according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

#### **1.6 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.

### **PART 2 - PRODUCTS**

## 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- H. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

## 2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

### **3.2 EXCAVATION, GENERAL**

- A. **Unclassified Excavation:** Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.3 EXCAVATION FOR STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. **Excavations for Footings and Foundations:** Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### **3.4 EXCAVATION FOR PAVEMENTS**

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### **3.5 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
  - 1. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
  - 2. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
- D. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 1. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
  - 2. Excavate trenches 6 deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

### **3.6 SUBGRADE INSPECTION**

- A. Notify Soils Engineer when excavations have reached required subgrade.
- B. If Soils Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Soils Engineer, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### **3.7 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

### **3.8 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### **3.9 BACKFILL**

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Surveying locations of underground utilities for Record Documents.
  - 2. Removing concrete formwork.
  - 3. Removing trash and debris.
  - 4. Removing temporary shoring and bracing.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### **3.10 UTILITY TRENCH BACKFILL**

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.11 SOIL FILL**

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under future grass and planted areas, use satisfactory soil material.
  - 2. Under pavements, use satisfactory soil material.
  - 3. Under building slabs, use engineered fill.
  - 4. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### **3.12 SOIL MOISTURE CONTROL**

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### **3.13 COMPACTION OF SOIL BACKFILLS AND FILLS**

- A. Place backfill and fill soil materials in layers not more than 8 inches loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under pavement, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

### **3.14 GRADING**

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Future Lawn or Unpaved Areas: Plus or minus 1 inch
  2. Pavements: Plus or minus 1/2 inch.

### **3.15 SUBBASE AND BASE COURSES**

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
  1. Place base course material over subbase course under hot-mix asphalt pavement.
  2. Shape subbase and base course to required crown elevations and cross-slope grades.
  3. Place subbase and base] course 6 inches or less in compacted thickness in a single layer.
  4. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less

than 95 percent of maximum dry unit weight according to ASTM D 698.

### **3.16 DRAINAGE COURSE**

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
  - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### **3.17 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 750 sq. ft or less of paved area or building slab, but in no case fewer than 3 tests.
  - 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
  - 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

### **3.18 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Soils Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
  - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300

## **SECTION 02510 WATER DISTRIBUTION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes water-distribution piping and specialties outside the building for the following:
  - 1. Domestic Water Services.
  - 2. Division 1 Section "Alternates" for work at Trash Transfer Building.

#### **1.3 DEFINITIONS**

- A. Fire-Service Main: Exterior fire-suppression-water piping.
- B. Water Service: Exterior domestic-water fire protection piping.

#### **1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Valves and accessories.
  - 2. Backflow preventers and assemblies.
  - 3. Fire hydrants.
- B. Shop Drawings and Material Cutsheets:
  - 1. Fire Hydrants and associated piping and valves.
- C. Field Quality-Control Test Reports: From Contractor.
- D. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures, and Operation and Maintenance Data," include the following:
  - 1. Valves.

2. Fire Hydrants

**1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Regulatory Requirements:
  - 1. Comply with requirements of Denver Water Department. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of Denver Water Department for potable-water-service piping, including materials, installation, testing, and disinfection.
  - 3. Comply with standards of Denver Water Department for fire hydrants including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

## **1.7 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.

## **1.8 COORDINATION**

- A. Coordinate connection to water main with Denver Water Department.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### **2.3 DUCTILE-IRON PIPE AND FITTINGS**

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- B. Acceptable Manufacturers:
1. American Cast Iron Pipe Company.
  2. Griffin Pipe Products Company.
  3. Pacific State Cast Iron Pipe Company.
  4. United States Pipe and Foundry Company.
  5. McWane Cast Iron Pipe Company (3 inch - 4 inch only).
- C. Place of Manufacturer:
1. Ductile iron pipe to be installed in the City and County of Denver and Total Services Areas shall be of domestic manufacture.
- D. Ductile Iron Fittings
1. Ductile iron fittings shall be manufactured in accordance with AWWA C110, or C153 as applicable with the following additional requirements or exceptions.
  2. Joint Type: Fittings installed in the City and County of Denver or Total Service Areas shall be furnished with mechanical joint ends conforming to AWWA C111 with tee-head bolts and hexagon nuts fabricated from a high-strength, low alloy steel known as Cor-Ten, Usalloy, or Durabolt.  
  
Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished and packaged separately from the fittings. Each package shall be labeled in such a manner as to provide for proper identification and the number of units per package or bundle.
  3. Pressure Rating: Ductile iron fittings, nominal size 3 inch through 24 inch, shall have a pressure rating of 350 psi, and nominal size 30 inch through 42 inch shall have a pressure rating of 250 psi.
  4. Material Strength: The grade of iron shall be 70-50-05.
  5. Linings and Coatings: Ductile iron fittings shall be coated with an asphaltic material and lined with cement-mortar and given a seal coat of asphaltic materials in accordance with AWWA C104. Ductile iron fittings may also be lined and coated with fusion-bonded epoxy in accordance with AWWA C116.

6. Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standards herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water Department.
7. Acceptable Manufacturers:  
  
Tyler Pipe Industries  
United States Pipe and Foundry Company  
Griffin Pipe Products Company  
Union Foundry Company  
Star Pipe Products  
Sigma

## 2.4 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), water tube, annealed temper.
  1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), water tube, drawn temper.
  1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

## 2.5 JOINING MATERIALS

- A. Transition Couplings:
  1. Underground Piping, NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
  2. Underground Piping, NPS 2 (DN 50) and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
  3. Aboveground or Vault Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Soldering Flux: ASTM B 813, water-flushable type.

- D. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.

**2.6 CORROSION-PROTECTION ENCASUREMENT FOR PIPING**

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

**2.7 GATE VALVES**

- A. AWWA, Cast-Iron Gate Valves:

Acceptable Manufacturers:	<b><u>C509</u></b>	<b><u>C513</u></b>
American AVK Co.; Valves & Fittings Div.	X	X
American Flow Control Div.	X	X
Clow	X	
East Jordan Iron Works, Inc.	X	X
Kennedy	X	
Mueller Co.; Water Products Div.	X	
United States Pipe and Foundry Company.	X	

- B. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Valves shall open by turning to the right.
  - 1. Minimum Working Pressure: 200 psig.
  - 2. End Connections: Mechanical joint per AWWA CM.
  - 3. Interior Coating: Complying with AWWA C509 or AWWA C515..

**2.8 GATE VALVE ACCESSORIES AND SPECIALTIES**

- A. Taping Valves - Mechanical Joint Type
  - 1. Tapping valves shall be designed and manufactured in accordance with AWWA C509 or AWWA C515 as applicable, with the following additional requirements or exceptions.
  - 2. Valve Description: Valves shall be ductile iron body, resilient seated gate valve with non-rising stems. If the resilient seats are bonded to the gates, the gates shall be totally encapsulated with the material, with the exception of any guide tabs or slots.
  - 3. Installation: Valves will be installed with the stem vertical in buried horizontal water lines without gearing, by-passes, rollers or tracks.
  - 4. Service: Valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be

capable of operating satisfactorily with flows in either direction. The operating pressure for all sizes shall be 200 psig.

5. Valve Stem: Valve stems shall be made of bronze in accordance with ASTM B 763, Copper Alloy No. C99500 or stainless steel in accordance with ASTM A 276, Type 304 or 316; or AISI 420.

Valves shall be furnished with 2 inch square wrench nuts. Stem seal shall consist of two (2) O-rings. Valves shall open by turning to the right.

6. Bolting Material: Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance, or electro-plated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

7. End Connections:

- a. Inlet End of Valve: Inlet end of the valve shall be flanged. Dimensions and drilling of this flange shall conform to ANSI B16.1, Class 125. Flange faces shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.
- b. Outlet End of Valve: Outlet end of the valve shall have a standard mechanical joint end conforming to AWWA C111. The face of the mechanical joint shall have a sufficiently smooth and even surface to allow a tight O-ring seal with the tapping equipment. Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished. The tee-head bolts and hexagon nuts shall be fabricated from a high-strength low alloy steel known in the industry as Cor-Ten, Usalloy, or Durabolt. Both ends of valve shall be covered for shipment, and the mechanical joint accessories shall be packed inside the body of the valve.

8. Seat Ring Size: Body of the valve and seat opening shall be sized large enough to accommodate the following sizes of shell cutters:

<u>Tapping Valve Nominal Diameter</u>	<u>Shell Cutter Diameter</u>
4"	3 7/8" ±1/32"
6"	5 13/16" ±1/32"
8"	7 7/8" ±1/32"
10"	9 3/4" ±1/32"
12"	11 7/8" ±1/32"

9. Testing: Each valve, after shop assembly, shall be given the operation and hydrostatic tests in accordance with AWWA C509 or AWWA C515.
  10. Coating: Valves shall be painted or coated in accordance with AWWA C509, or AWWA C515. Machined flange faces shall not be painted or coated with the same coating as the body, but shall be evenly coated with a rust preventative compound.
  11. Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.
  12. Acceptable Manufacturers:  
  
American AVK  
Mueller  
Clow  
Kennedy  
United States Pipe and Foundry Company  
American Flow Control Series 2500 RW
- B. Valve Boxes: Comply with ASTM A48 Class 35B for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch (125-mm) diameter barrel.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FM-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
- D. Indicator Posts: UL 789, FM-approved, horizontal, wall-type, cast-iron body with operating wrench, extension rod, and cast-iron barrel.
- E. Acceptable Manufacturer:
- Tyler screw-type 6 inch cast iron valve box assembly Series 6860 with No. 160 oval base.
- Star Pipe Model No. VBD160DMWW  
Olympic Foundry Inc. Model No. 450VB

Castings Inc. Cl. 160 Oval Base  
East Jordan Iron Works Series 8560

**2.9 CORPORATION VALVES STOPS AND CURB VALVES STOPS**

- A. General: All of the following brass goods shall be manufactured in accordance with AWWA C800, and all of the following bronze goods shall be manufactured using copper alloy UNS No. C83600 commercially known as 85-5-5 in accordance with ASTM B 62, with the following additional requirements or exceptions.

Each manufacturer shall submit samples to Denver Water for testing. If the manufacturer is approved, the sample shall be kept by Denver Water and used as the standard by which future purchases shall be compared.

- B. Corporation Stops: Corporation stops shall be AWWA Standard taper to copper and shall be of the type listed below or equal, approved by Denver Water:

Mueller	B25000	(Sizes 3/4" - 2")
Ford	F-600	(Sizes 3/4" - 2")
McDonald	#4701	(Sizes 3/4" - 2")
Farnan	#W-100	(Sizes 3/4" - 2")
Ford	#FB-600	(Sizes 1"-2")
Cambridge Brass	#102	(Sizes 3/4" - 2")

- C. Curb Stops: Curb stops shall be copper to copper and shall be of the type listed below or equal, approved by Denver Water:

Ford Ball Type	#B -22	(Sizes 3/4" - 2")
Mueller	B25204	(Sizes 3/4" - 2")
A.Y. McDonald	#6100	(Sizes 3/4" - 2")
James Jones	#J -1902	(Sizes 3/4" - 1")
James Jones	#J -1901	(Sizes 1-1/2" - 2")
with coupling	#J -1531	
Hays	#4303	(Size 3/4")
Cambridge Brass	#202	(Sizes 3/4" - 2")

**2.10 FREESTANDING FIRE HYDRANTS**

- A. Dry-Barrel Fire Hydrants
1. Except as modified or supplemented herein, all fire hydrants shall be designed and manufactured in strict compliance with AWWA C502 with the following additional requirements or exceptions. All references made in this Specification are to the above standard unless otherwise noted.

2. Service: All fire hydrants supplied under these Specifications shall be designed for a working pressure of 150 psi and each factory assembled unit shall be hydrostatically tested in accordance with AWWA C502. Shop tests for the body and main valve will be conducted at a pressure of 300 psi.
3. Size of Hydrant: All hydrants shall have a main valve opening size of at least five and one quarter (5-1/4) inches.
4. Type of Hydrant: Hydrants shall be the three-way type with one pumper nozzle and 2 hose nozzles all located on the same horizontal plane, at least 18 Inches above ground line.
5. Inlet Connection: Hydrant base shall be provided with a mechanical joint Inlet to accommodate 6 inch diameter ductile iron pipe complete with plain rubber gasket, gland, bolts and nuts all in accordance with AWWA C111.

The bolts and nuts shall be a high strength low alloy corrosion resistant steel Cor-Ten or equal with a minimum yield of 50,000 psi conforming to ASTM A 242. Incorporated into the base shall be two lugs for rodding of pipe.

All mechanical joint accessories shall be attached to hydrant for shipment.

6. Main Valve Assembly: Main valve of the hydrant shall be the compression type which closes with the water pressure. Seat ring shall be bronze with a machined face and external threads for threading into a bronze drain ring, or a bronze bushed shoe to provide bronze to bronze seating for the main valve. The assembly shall be sealed with O-rings.

Main valve shall be replaceable type fabricated of a resilient material with a threaded bottom plate or nut with a seal to prevent leakage of the hydrant shaft. The upper valve plate material shall be either bronze or epoxy coated ductile iron.

The valve assembly shall include one or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position. All drain tubes shall be bronze lined and sized large enough for the barrel to drain within 12 minutes when the barrel is sized for a 5 foot trench depth.

All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation in accordance with AWWA C502.

7. **Operating Shaft and Nut:** The operating nut shall be bronze or ductile iron and shall be pentagon shaped with a finished height of 1-1/8 inch. The dimensions from point-to-flat shall be between 1-1/4 inch and 1-3/8 inch from the top and to the bottom of the nut. Bushings in the bonnet shall be so constructed that it will prevent the operating nut from traveling during opening or closing operation. Also the bushing shall house a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

All hydrants shall be grease lubricated or shall be the dry-top design where an oil reservoir provides permanent lubrication of the operating nut threads.

A stop nut located in the hydrant bonnet on the operating shaft shall prevent over travel of the main valve when being opened.

The hydrant shall open by turning the operating nut to the right (in a clockwise direction) and shall have an arrow on top of the bonnet to designate the direction of opening.

8. **Pumper Nozzle and Cap:** The pumper nozzle shall be 4-1/2 inches nominal diameter with 5-3/8 inch outer diameter threads having 6 threads per inch. Threads shall be right-hand. It shall be the supplier's responsibility to match the thread requirements for Denver Water's hydrants. A sample nozzle will be furnished upon request.

Nozzle cap shall be furnished with a synthetic rubber gasket installed in a retaining groove and the dimensions and shape of the nozzle cap nut shall be the same as the operating shaft nut as described above.

Nozzle caps shall be furnished with security chains with one end of each securely attached to the upper barrel section of the hydrant.

9. **Hose Nozzles and Caps:** The two hose nozzles shall be 2-1/2 inch nominal diameter with 7-1/2 threads per inch (2.5 - 7.5 N.H.). Threads shall be right-hand and National Standard in accordance with, NFPA No. 194. Each hose nozzle shall include a nozzle cap with nut and security chain the same as described above.
10. **Nozzle Attachment:** Outlet nozzles shall be fastened into the barrel by mechanical means and secured by a stainless steel pin or screw, bronze wedge or a ductile iron retainer. Nozzles shall be sealed by the use of O-rings.

11. Coatings: The upper exposed section of the hydrant above ground shall be thoroughly cleaned and then painted with a prime coat of a rust inhibitive primer followed by a 10 mil thick shop coat of heavy duty alkyd enamel paint. The paint color shall be red per City & County of Denver requirements.

All exposed exterior surfaces below the ground line shall be coated with asphalt varnish or equal in accordance with AWWA C502.

The interior of the hydrants shall be coated with an epoxy coating in accordance with AWWA C502. The epoxy paint shall be NSF/ANSI 61 approved.

12. Certification: Manufacturer shall furnish a sworn statement stating that all hydrants furnished comply with all applicable provisions of AWWA C502 as modified or supplemented herein. A copy of the Certification including interior epoxy paint compliance with NSF/ANSI 61 shall be sent to Denver Water.
13. Traffic Features: All hydrants shall be equipped with traffic features that include a breakaway flange or lug system with a shaft coupling.
14. Acceptable Manufacturers:

<u>Manufacturer</u>	<u>Model No.</u>
Mueller Company	Centurion Model A-473
American Flow Control/Waterous	Pacer WB-67-250
Clow F-2545	Metropolitan 250 M-94
Kennedy K-81D	
AVK Series	

These brand names are the only ones considered for purchase by Denver Water, or for installation in the City and County of Denver and total service areas. Other hydrant brands with appropriate model and options may be utilized by distributor contract areas following approval for such use by Denver Water.

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

### **3.2 PIPING APPLICATIONS**

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Do not use flanges, unions, or keyed couplings for underground piping.
- D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

### **3.3 PIPING INSTALLATION**

- A. Water-Main Connection: Arrange with Denver Water for tap of size and in location indicated in water main.
- B. Make connections larger than NPS 2 in accordance with Denver Water Department requirements.
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- D. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- E.. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
- F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

### **3.4 ANCHORAGE INSTALLATION**

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### **3.5 VALVE INSTALLATION**

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

**3.6 FIRE HYDRANT INSTALLATION**

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

**3.7 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 2 Sections. Drawings indicate general arrangement of piping and specialties.

**3.8 FIELD QUALITY CONTROL**

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

**3.9 IDENTIFICATION**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 2 Section "Earthwork" for underground warning tapes.
- B. Permanently attach equipment nameplate or marker, indicating plastic water-service piping, on main electrical meter panel. See Division 2 Section "Utility Materials" for identifying devices.

**3.10 CLEANING**

- A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 02510

## **SECTION 02730 SANITARY SEWERAGE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.
- B. All work shall be in accordance with Denver Wastewater Requirements.

#### **1.2 SUMMARY**

- A. This Section includes sanitary sewerage and sand oil interceptor outside the building.

#### **1.3 DEFINITIONS**

- A. PVC: Polyvinyl chloride plastic.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

#### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Stainless-steel drainage systems.
  - 2. Manhole cover inserts.
  - 3. Sand & Oil Separator Systems.
  - 4. Identification tape.
  - 5. All different types of pipe used.
- B. Shop Drawings: Include plans, elevations, details, and attachments for the following:
  - 1. Precast concrete manholes, including frames and covers.

2. Cast-in-place concrete manholes and other structures, including frames and covers.
  3. Sand & Oil Separator Systems
- C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

## **1.7 PROJECT CONDITIONS**

- A. Site Information: Verify existing utility locations.
- B. Locate existing structures and piping to be closed, abandoned, and connected.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  1. Notify Architect not less than forty-eight hours in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without Architect's written permission.
- D. Project Record Documents: Accurately record location of pipe runs, connections, manholes and invert elevations. Show other piping in same trench and clearances from sanitary sewer piping. Indicate interface and spatial relationship between piping and proximate structures.

## **PART 2 - PRODUCTS**

### **2.1 SEWERAGE MATERIALS**

- A. All materials shall conform to the standard specifications of the City & County of Denver Wastewater Jurisdiction. The Contractor shall obtain a copy of requirements.
- B. PVC Sewer Pipe and Fittings: According to the following:
  - 1. PVC Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed join
    - a. Gaskets: ASTM F 477, elastomeric seals.
  - 2. PVC Sewer Pipe and Fittings, NPS 18 (DN450) and Larger: ASTM F 679, T-1 wall thickness, bell and spigot for gasketed joints.
    - a. Gaskets: ASTM F 477, elastomeric seals.
- C. Proper connections between dissimilar materials shall be used.

## **2.2 SPECIAL PIPE COUPLINGS AND FITTINGS**

- A. Sleeve-Type Pipe Couplings:
  - 1. Sleeve Material for Plastic Pipe: ASTM F 477, elastomeric seal.
  - 2. Sleeve Material for Dissimilar Pipe: Compatible with pipe materials being joined.
- B. Pipe Accessories
  - 1. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required "T", bends, elbows, cleanouts, reducers, traps, and other configurations.

## **2.3 PE FILM, PIPE ENCASEMENT**

- A. ASTM A 674 or AWWA C105; PE film, tube, or sheet; 8-mil (0.2-mm) thickness.

## **2.4 BEDDING**

- A. See Section 02200 Earthwork and City & County of Denver Wastewater Standards.

## **2.5 MANHOLE**

- A. Heavy-Traffic Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.
1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to structure, as required to prevent flotation.
  2. Gaskets: Rubber.
  3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
  4. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.
  5. Steps: Manufactured from deformed, 1/2-inch (13-mm) steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch (300- to 400-mm) intervals. Omit steps for manholes less than 60 inches (1500 mm) deep.
  6. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
  2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
  3. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch (300- to 400-mm) intervals. Omit steps for manholes less than 60 inches (1500 mm) deep.
  4. Steps: Manufactured from deformed, 1/2-inch (13-mm) steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step.

Cast or anchor into sidewalls with steps at 12- to 16-inch (300- to 400-mm) intervals. Omit steps for manholes less than 60 inches (1500 mm) deep.

- C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch (610-mm) ID by 7- to 9-inch (178- to 229-mm) riser with 4-inch (100-mm) minimum width flange, and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering "SANITARY SEWER" cast into cover.
- D. Manhole Cover Inserts: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
  - 1. Type: Solid.
  - 2. Type: With drainage and vent holes.
  - 3. Type: With valve.

## 2.6 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
  - 1. Cement: ASTM C 150, Type II.
  - 2. Fine Aggregate: ASTM C 33, sand.
  - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
  - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.
  - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.
  - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: 1 percent through manhole.

- b. Invert Slope: 2 percent through manhole.
- 2. Benches: Concrete, sloped to drain into channel.
  - a. Slope: 8 percent.
  - b. Slope: 4 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
  - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

## 2.7 PROTECTIVE COATINGS

- A. Description: One- or two-coat, coal-tar epoxy; 15-mil (0.38-mm) minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
  - 1. Concrete Manholes: On interior surface.
  - 2. Concrete Manholes: On exterior surface.
  - 3. Concrete Manholes: On exterior and interior surfaces.
  - 4. Manhole Frames and Covers: On entire surfaces.
  - 5. Manhole Frames and Covers: On surfaces that will be exposed to sewer gases.

## 2.8 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:
  - 1. Light Duty: In earth or grass foot-traffic areas.
  - 2. Medium Duty: In paved foot-traffic areas.
  - 3. Heavy Duty: In vehicle-traffic service areas.
  - 4. Extra-Heavy Duty: In roads.
  - 5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

## **2.9 SAND & OIL INTERCEPTORS**

- A. Basis-of -Design: Subject to compliance with requirements of City & County of Denver, provide the product indicated on the Drawings.
- B. Type: Factory-fabricated interceptor for separating and removing greases and oils from waste water.
  - 1. Body Material: Cast iron.
  - 2. Interior Lining: Corrosion-resistant enamel.
  - 3. Exterior Coating: Corrosion-resistant enamel.
  - 4. Body dimension: As shown on Drawings.
  - 5. Capacity: 1500 gallons.
  - 6. Inlet and Outlet Size: As shown on Drawings.
  - 7. Cleanout Plugs: Brass
  - 8. Concrete: In accordance with Section 03300 - 4000 psi, Type II cement.

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

### **3.2 IDENTIFICATION**

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
  - 1. Use warning tape or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### **3.3 PIPING APPLICATIONS**

- A. General: Include watertight joints.

- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.
- C. Gravity-Flow Piping: Use the following:
  - 1. NPS 4 and NPS 6 (DN100 and DN150): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
  - 2. NPS 8 and NPS 10 (DN200 and DN250): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
  - 3. NPS 12 and NPS 15 (DN300 and DN375): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
  - 4. Pipe Sizes NPS 18 to NPS 24 (DN450 to DN600): PVC sewer pipe and fittings, gaskets, and gasketed joints.

### **3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS**

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
  - 1. Use the following pipe couplings for nonpressure applications:
    - a. Sleeve type to join piping, of same size, or with small difference in OD.
    - b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
    - c. Bushing type to join piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Special Pipe Fittings: Use where indicated. Include PE film, pipe encasement.

### **3.5 INSTALLATION, GENERAL**

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
  - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
  - 2. Install piping with 36-inch minimum cover.
- F. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

### **3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION**

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
  - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
  - 2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
  - 3. Install according to ASTM D 2321.
- C. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- D. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

- E. Install with top surfaces of components, except piping, flush with finished surface.

### **3.7 MANHOLE INSTALLATION**

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.
- F. Adjust all existing and new manholes and cleanouts to final grade

### **3.8 CONCRETE PLACEMENT**

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

### **3.9 CLEANOUT INSTALLATION**

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

### **3.10 TAP CONNECTIONS**

- A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

- B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### **3.11 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS**

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with at least 8-inch- (200-mm-) thick, brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Structures: Excavate around structure as required and use one procedure below:
  - 1. Remove structure and close open ends of remaining piping.
  - 2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
  - 3. Backfill to grade according to Division 2 Section "Earthwork."

### **3.12 FIELD QUALITY CONTROL**

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
  - 1. Place plug in end of incomplete piping at end of day and when work stops.
  - 2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate reports for each test.
  5. Perform tests according to City & County of Denver Wastewater requirements.
  6. Manholes: Perform hydraulic test according to ASTM C969.
  7. Leaks and loss in test pressure constitute defects that must be repaired.
  8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 02730

## **SECTION 02741 HOT-MIX ASPHALT PAVING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Hot-mix asphalt paving.
  - 2. Hot-mix asphalt patching.
  - 3. Asphalt surface treatments.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
  - 3. Division 2 Section "Pavement Joint Sealants" for joint sealants and fillers at paving terminations.

#### **1.3 DEFINITIONS**

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

#### **1.4 SYSTEM DESCRIPTION**

- A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of the City & County of Denver.

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Qualification Data: For manufacturer.

- D. Material Test Reports: For each paving material.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer shall be a paving-mix manufacturer registered with and approved the City and County of Denver.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
  - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
  - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
  - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations, PER cdot Class 5 or 6.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
  - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO MP 1, PG 64-22 or PG 58-28.
- B. Asphalt Cement: AC-10 or AC-20 per CDOT.

- C. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.
- D. Prime Coat: Asphalt emulsion prime complying with CDOT requirements.
- E. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- F. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- G. Water: Potable.
- H. Undersealing Asphalt: ASTM D 3141, pumping consistency.

## **2.3 MIXES**

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types";] and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Base Course: Grading S.
  - 3. Surface Course: Grading SX.
- B. Emulsified-Asphalt Slurry: ASTM D 3910, Type [1] [2] [3], consisting of emulsified asphalt, fine aggregate, and mineral fillers.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

### **3.2 PATCHING**

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise

indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
- D. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

### **3.3 SURFACE PREPARATION**

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
  - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.
  - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  - 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### **3.4 HOT-MIX ASPHALT PLACING**

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a

manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  2. Place hot-mix asphalt surface course in single lift.
  3. Spread mix at minimum temperature of 250 deg F.
  4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
  5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### **3.5 JOINTS**

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
  5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  6. Compact asphalt at joints to a density within 2 percent of specified course density.

### **3.6 COMPACTION**

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown

rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
  - 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### **3.7 INSTALLATION TOLERANCES**

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### **3.8 ASPHALT CURBS**

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F.
  - 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### **3.9 SURFACE TREATMENTS**

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With a fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
  - 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

### **3.10 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
  - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
  - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
  - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### **3.11 DISPOSAL**

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an City & County of Denver approved landfill.
  1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 02741

## **SECTION 02751 CEMENT CONCRETE PAVEMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Condition (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Driveways and aprons.
  - 2. Walkways.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for Trash Transfer Building.
  - 2. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
  - 3. Division 2 Section "Pavement Joint Sealants"
  - 4. Division 3 Section "Cast-in-Place Concrete for general building applications of concrete.

#### **1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, bent bar diagrams, bar arrangement, splices and

laps, mechanical connections, tie spacing, and supports for concrete reinforcement.

- D. Qualification Data: For manufacturer.
- F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements:
  - 1. Aggregates.
- G. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Steel reinforcement and reinforcement accessories.
  - 4. Form materials and form-release agents.
  - 5. Curing compounds.
  - 6. Bonding agent.
  - 7. Joint fillers.
  - 8. Repair materials

## 1.5 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. 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."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. 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.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
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.
  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, anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

## **1.6 PROJECT CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## **PART 2 - PRODUCTS**

### **2.1 FORMS**

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. 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.

### **2.2 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- C. Plain Steel Wire: ASTM A 82, galvanized.
- D. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- E. Tie Bars: ASTM A 615/A 615M, Grade 60 Grade, deformed.
- F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

## **2.3 CONCRETE MATERIALS**

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: ASTM C 150, Type I, gray
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M coarse aggregate, uniformly graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 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.

## **2.4 CURING MATERIALS**

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.
- C. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
  - 1. Products:
    - a. Euclid Chemical Company (The); Eucobar.
    - b. Sika Corporation, Inc.; SikaFilm.
- D. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
  - 1. Products:
    - a. Euclid Chemical Company (The); Kurez DR VOX.
    - b. Symons Corporation; Resi-Chem Clear.

## **2.5 RELATED MATERIALS**

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
  - 1. Manufacturers:
    - a. ChemMasters.
    - b. Elementis Pigments, Inc.
  - 2. Color: As selected by Architect from manufacturer's full range.

## **2.6 CONCRETE MIXTURES**

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 4000 psi.

2. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
  1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  1. Use water-reducing 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.

## **2.7 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
  1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
  1. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 2 Section "Earthwork."
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### **3.2 PREPARATION**

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

### **3.3 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### **3.4 STEEL REINFORCEMENT**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### **3.5 JOINTS**

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  - 2. Provide tie bars at sides of pavement strips where indicated.

3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  5. 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.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
  2. Extend joint fillers full width and depth of joint.
  3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows and as indicated on the Drawings:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
  2. Doweled Contraction 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.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

### **3.6 CONCRETE PLACEMENT**

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
- J. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- K. Screed pavement surfaces with a straightedge and strike off.
- L. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength or as approved by Owner.

- L. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
  
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### **3.7 FLOAT FINISHING**

- A. General: Do not add water to concrete surfaces during finishing operations.
  
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Medium Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

### **3.8 CONCRETE PROTECTION AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  
- B. Comply with ACI 306.1 for cold-weather protection.

- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x 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.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  - 1. Moist 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 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, and sealed by waterproof tape or adhesive. 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.

### 3.9 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
  - 1. Elevation: 1/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
  - 4. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
  - 5. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
  - 6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
  - 7. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
  - 8. Joint Width: Plus 1/8 inch, no minus.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
- C. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

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.

- 1. 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 mix. Perform additional tests when concrete consistency appears to change.
  - 2. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  - 3. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  - 4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  - 5. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
    - b. Strength of each concrete mix will be satisfactory if average of any 3 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.
- D. Test results shall be reported in writing to Architect, 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.
  - E. 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 Architect.

- F. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.11 REPAIRS AND PROTECTION**

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 02751

## **SECTION 02764 PAVEMENT JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 2 Section "Hot-Mix Asphalt Paving" for constructing joints between concrete and asphalt pavement.
2. Division 2 Section "Cement Concrete Pavement" for constructing joints in concrete pavement.
3. Division 7 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

#### **1.3 SUBMITTALS**

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

## **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the Work.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## **1.6 PROJECT CONDITIONS**

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  - 2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 3. When joint substrates are wet or covered with frost.
  - 4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### **2.2 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### **2.3 COLD-APPLIED JOINT SEALANTS**

- A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:
  - 1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
    - a. Products:
      - 1. Pecora Corporation; Urexpam NR-300.
      - 2. Tremco Sealant/Waterproofing Division; Vulkem 202.

### **2.4 JOINT-SEALANT BACKER MATERIALS**

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

### **2.5 PRIMERS**

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### **3.3 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of backer materials.
  - 2. Do not stretch, twist, puncture, or tear backer materials.
  - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses provided for each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealants from surfaces adjacent to joint.
  - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

### **3.4 CLEANING**

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

### **3.5 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 02764

## **SECTION 03300 CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section specifies 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. Building walls.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 2 Section "Earthwork" for subgrade preparation, grading, and drainage fill under slabs-on-grade.
  - 3. Division 2 Section "Cement Concrete Pavement".
  - 4. Division 3 Precast Architectural Concrete.

#### **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 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. 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.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. 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.
- D. Welding certificates.
- E. Qualification Data: For manufacturer.
- F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  1. Aggregates.
- G. 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. Waterstops.
  6. Curing compounds.
  7. Bonding agents.
  8. Adhesives.
  9. Semirigid joint fillers
  10. Joint-filler strips.
  11. Repair materials.
- H. Field quality-control test and inspection reports.

## 1.5 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. 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."
- C. Testing Agency Qualifications: An independent agency 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 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: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. 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.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
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.
  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, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness

measurement, concrete repair procedures, and concrete protection.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## **1.7 PROJECT CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## **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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### **2.2 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. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. 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.
- G. 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 to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### **2.3 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 , deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Wire: ASTM A 82, galvanized.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

### **2.4 REINFORCEMENT ACCESSORIES**

- A. 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.

## **2.5 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. 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.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S, coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.

## **2.6 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. 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.

1. Products:

- a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
- b. Henry Company, Sealants Division; Hydro-Flex.
- c. JP Specialties, Inc.; Earthshield Type 20.
- d. Progress Unlimited, Inc.; Superstop.

## 2.7 FLOOR AND SLAB TREATMENTS

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

Products:

Burke by Edoco; Titan Hard.  
ChemMasters; Chemisil Plus.  
ChemTec International; ChemTec One.  
Curecrete Distribution Inc.; Ashford Formula.  
Euclid Chemical Company (The); Euco Diamond Hard.  
L&M Construction Chemicals, Inc.; Seal Hard.  
Meadows, W. R., Inc.; Liqui-Hard.  
Nox-Crete Products Group, Kinsman Corporation; Duranox.  
Symons Corporation, a Dayton Superior Company; Buff Hard.

## 2.8 CURING MATERIALS

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

1. Products:

Axim Concrete Technologies; Cimfilm.  
Burke by Edoco; BurkeFilm.  
ChemMasters; Spray-Film.  
Euclid Chemical Company (The); Eucobar.  
L&M Construction Chemicals, Inc.; E-Con.  
Meadows, W. R., Inc.; Sealtight Evapre.  
Nox-Crete Products Group, Kinsman Corporation; Monofilm.  
Sika Corporation, Inc.; SikaFilm.  
Symons Corporation, a Dayton Superior Company; Finishing Aid.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. 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.

Products:

Burke by Edoco; Aqua Resin Cure.  
ChemMasters; Safe-Cure Clear.  
Euclid Chemical Company (The); Kurez DR VOX.  
Lambert Corporation; Aqua Kure-Clear.  
L&M Construction Chemicals, Inc.; L&M Cure R.  
Meadows, W. R., Inc.; 1100 Clear.  
Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.  
Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.  
Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch 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 or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi 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 1/8 inch 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 topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

## **2.11 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: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 20 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. 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.

## **2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS**

- A. Footings: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50
  - 3. Slump Limit: 4, plus or minus 1 inch.
  - 4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
  
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
  
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 6 percent at exterior slabs and 3 percent at interior slabs, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
  - 6. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
  
- D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

## **2.13 FABRICATING REINFORCEMENT**

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

## **2.14 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM 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; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION FOR SLABS-ON-GRADE**

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
  - 2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 2 Section "Earthwork."
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### **3.2 FORMWORK**

- A. Slab-On-Grade Edge Forms and Screed Construction - Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- B. 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.
- C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class C, 1/2 inch for rough-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. 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.

- G. Install keyways, reglets, recesses, and the like, for easy removal.
  - 1. Do not use rust-stained steel form-facing material.
- H. 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.
- I. 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.
- J. Chamfer exterior corners and edges of permanently exposed concrete.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### **3.3 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."

### **3.4 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 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. 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 Architect.

### **3.5 STEEL REINFORCEMENT**

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

### **3.6 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 or as approved by Architect.
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 into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans
  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. 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. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch 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. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
  2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### **3.7 WATERSTOPS**

- A. 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.

### **3.8 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 Architect.

- 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 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 in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F 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.

### 3.9 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.
- 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.
- 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.

### **3.10 FINISHING FLOORS AND SLABS**

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. 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 restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.
- C. 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 or exposed to view.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and 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 Architect before application.

### **3.11 MISCELLANEOUS CONCRETE ITEMS**

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. 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.

### 3.12 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 lb/sq. ft. x 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 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, 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.
  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.

### **3.13 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 month. 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 deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### **3.14 CONCRETE SURFACE REPAIRS**

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect'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 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 in any dimension in solid concrete, but not less than 1 inch in depth. 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 Architect.
- 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 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 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 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 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 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 Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### **3.15 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. Inspections:
  1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Verification of use of required design mixture.
  4. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. 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., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  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; 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 and below and when 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M.:

- a. Cast and laboratory cure four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days, two specimens at 28 days, and one specimen at 56 days, as required.
    - a. 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.
  7. 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.
  8. 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.
  9. Test results shall be reported in writing to Architect, 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.
  10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  11. 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 Architect. 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 Architect.
  12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03300

## **SECTION 03450 PRECAST ARCHITECTURAL CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions ( City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Insulated, precast architectural concrete panels.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide precast architectural concrete panels and connections capable of withstanding design loads within limits and under conditions indicated.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixes: For each concrete mix.
- C. Shop Drawings: Detail fabrication and installation of precast architectural concrete panels. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish, and types of reinforcement, including special reinforcement.
  - 1. Indicate separate face and backup mix locations and thicknesses.
  - 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
  - 3. Indicate locations and details of anchorage devices to be embedded in other construction.
  - 4. Comprehensive engineering analysis certified by the qualified professional engineer responsible for its preparation.
- D. Samples: For each type of finish indicated on exposed surfaces of precast architectural concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

- E. Welding Certificates: Copies of certificates for welding procedures and personnel.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article 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.
- G. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
- H. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
  - 1. Concrete materials.
  - 2. Reinforcing materials and prestressing tendons.
  - 3. Admixtures.
  - 4. Water-absorption test reports.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed precast architectural 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. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast architectural concrete panels similar to those indicated for this Project and with a record of successful in-service performance.
  - 1. Assumes responsibility for engineering precast architectural concrete panels to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 2. 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 installations of precast architectural concrete that are similar to those indicated for this Project in material, design, and extent.
  - 3. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group A, Category A1--Architectural Cladding. Has sufficient production capacity to produce required units without delaying the Work.
  - 4. Is registered with and approved by authorities having jurisdiction.

- C. Testing Agency Qualifications: An independent testing agency, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."
- E. 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."
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel."

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver precast architectural concrete panels to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.
- B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

## **1.7 SEQUENCING**

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

## **PART 2 - PRODUCTS**

### **2.1 FABRICATORS**

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
  - 1. Stresscon Styrocore
  - 2. Rocky Mountain Prestress

### **2.2 MOLD MATERIALS**

- A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes

- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated.

## **2.3 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:
  - 1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60.
- D. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips, as follows:
  - 1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60.
- E. Plain-Steel Wire: ASTM A 82.
- F. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from steel wire into flat sheets.
- G. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice," PCI MNL 117, and as follows:
  - 1. For uncoated reinforcement, use all-plastic bar supports.

## **2.4 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, of same type, brand, and source.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S.
  - 1. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining.
    - a. Gradation: Uniformly graded
  - 2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.
- C. Coloring Admixture: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.

- D. 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.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Water-Reducing Admixture: ASTM C 494, Type A.
- G. Retarding Admixture: ASTM C 494, Type B.
- H. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- I. Plasticizing Admixture: ASTM C 1017.
- J. Fly Ash Admixture: ASTM C 618, Class C or F.

## **2.5 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
- D. 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, after fabrication, and ASTM A 153/A 153M, as applicable.
  - 1. 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.
- E. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast architectural concrete units.

## **2.6 GROUT MATERIALS**

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. 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, of consistency suitable for application.

## **2.7 INSULATED PANEL ACCESSORIES**

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using HCFCs as blowing agents; square edged; complying with ASTM C 578, Type IV, 1.6-lb/cu. ft. minimum density.

## **2.8 CONCRETE MIXES**

- A. Prepare design mixes for each type of concrete required.
  - 1. Limit use of fly ash and silica fume to not exceed, in aggregate, 25 percent of portland cement by weight.
- B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast architectural concrete fabricator's option.
- C. Normal-Weight Concrete Face and Backup Mixes: Proportion mixes 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.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- D. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL 117.
- E. 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.
- F. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

## **2.9 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 operations.
  - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast architectural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Edge and Corner Treatment: Uniformly radiused.

## 2.10 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.
- B. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.
- C. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and 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.
  - 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 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. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- D. Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.
- E. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
- F. Place face mix to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting, and placing concrete.
- H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 117.

- I. Identify pickup points of precast architectural 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 architectural concrete unit on a surface that will not show in finished structure.
- J. 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.
- K. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by Architect.

## **2.11 INSULATED PANEL CASTING**

- A. Cast and screed supported wythe over mold.
- B. Immediately place insulation boards, abutting edges and ends of adjacent boards. Stagger end joints between rows. Stagger joints of insulation layers one-half board apart. Insert wythe connectors through predrilled insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed structural wythe and apply initial float finish.

## **2.12 FABRICATION TOLERANCES**

- A. Fabricate precast architectural 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 precast architectural 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 or under, plus or minus 1/8 inch.
  - 2. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
  - 3. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches or 1/2 inch total, whichever is greater.
  - 4. Bowing: Plus or minus L/360, maximum 1 inch.
  - 5. Local Smoothness: 1/4 inch per 10 feet.
  - 6. Warping: 1/16 inch per 12 inches of distance from the nearest adjacent corner.
  - 7. Tipping and Flushness of Plates: Plus or minus 1/4 inch.

8. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.
- 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.
  2. Inserts: Plus or minus 1/2 inch.
  3. Handling Devices: Plus or minus 3 inches.
  4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
  5. Location of Rustication Joints: Plus or minus 1/8 inch.
  6. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.

### **2.13 FINISHES**

- A. Finish exposed-face surfaces of precast architectural concrete units to match approved design reference sample and as follows:
1. Design Reference Sample: Stresscon Cinnamon Mix ID SC501.
  2. PCI and APA's "Architectural Precast Concrete--Color and Texture Selection Guide," of plate numbers indicated.
  3. Smooth-Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs, with uniform color and texture.
  4. 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 precast architectural concrete panels to match face-surface finish.

### **2.13 SOURCE QUALITY CONTROL**

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements.
- B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements.
- C. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, Precast Fabricator 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.
1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  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 the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no

single core is less than 75 percent of the 28-day design compressive strength.

4. Test results will be made in writing on the same day that tests are performed, with copies to Architect, 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 or units 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.
- D. 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 mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- E. Defective Work: Precast architectural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Do not install precast concrete units until supporting concrete has attained minimum design compressive strength.

### **3.2 INSTALLATION**

- A. Install clips, hangers, and other accessories required for connecting precast architectural concrete units to supporting members and backup materials.
- B. Install precast architectural concrete. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  2. Remove projecting hoisting devices and use sand-cement grout to fill voids within recessed hoisting devices flush with surface of concrete.
- C. Anchor precast architectural concrete units in position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.
- D. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.
1. Protect precast architectural concrete units from damage by field welding or cutting operations and provide noncombustible shields as required.
  2. Repair damaged steel surfaces by cleaning and applying a coat of galvanizing repair paint to galvanized surfaces.
  3. Repair damaged steel surfaces by cleaning and repriming damaged painted surfaces.
- E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

### **3.3 ERECTION TOLERANCES**

- A. Install precast architectural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
- B. Install precast architectural 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.
  2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
  3. Top Elevation from Nominal Top Elevation: As follows:
    - a. Exposed Individual Panel: Plus or minus 1/4 inch.
  4. Support Elevation from Nominal Support Elevation: As follows:
    - a. Maximum Low: 1/2 inch.
    - b. Maximum High: 1/4 inch.
  5. Plumb in Any 10 Feet of Element Height: 1/4 inch.
  6. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
  7. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.

### **3.4 REPAIRS**

- A. Repair exposed exterior surfaces of precast architectural concrete units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect.
- B. Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.

### **3.5 CLEANING**

- A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.
  - 1. Wash and rinse according to precast concrete fabricator's written recommendations. 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.

END OF SECTION 03450

## **SECTION 04810 UNIT MASONRY ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Concrete masonry units (CMUs).
  - 2. Mortar and grout.
  - 3. Reinforcing steel.
  - 4. Masonry joint reinforcement.
  - 5. Ties and anchors.
  - 6. Miscellaneous masonry accessories.
- B. Products installed, but not furnished, under this Section include the following:
  - 1. Steel lintels for unit masonry, furnished under Division 5 Section "Metal Fabrications."
- C. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building.

#### **1.3 DEFINITIONS**

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
  - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

- C. Qualification Data: For testing agency.
- D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
  - 1. Masonry units.
    - a. Include material test reports substantiating compliance with requirements.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Include description of type and proportions of ingredients.
  - 5. Reinforcing bars.
  - 6. Joint reinforcement.
  - 7. Anchors, ties, and metal accessories.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
  - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

## **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single

manufacturer for each cementitious component and from one source or producer for each aggregate.

- D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
  2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
  3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## 1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
  2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## **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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### **2.2 MASONRY UNITS, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

### **2.3 CONCRETE MASONRY UNITS (CMUs)**

- A. Shapes: Provide shapes indicated and as follows:
  - 1. Provide special shapes for lintels, corners, jambs, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
  - 2. Weight Classification: Medium Weight, unless otherwise indicated].
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: ASTM C 91.
- E. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Products:
    - a. Addiment Incorporated; Mortar Kick.
    - b. Euclid Chemical Company (The); Accelguard 80.
    - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
    - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- H. Water: Potable.

## **2.5 REINFORCEMENT**

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized, carbonsteel.
  - 3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

## **2.6 TIES AND ANCHORS**

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
  - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
  - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
- B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from steel sheet, galvanized after fabrication not less than 0.043 inch thick. Ties made from galvanized steel sheet may be used in interior walls, unless otherwise indicated.

## **2.7 MISCELLANEOUS ANCHORS**

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: L-shaped] steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- C. Postinstalled Anchors: 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 solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).

## **2.8 MORTAR AND GROUT MIXES**

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  1. For reinforced masonry, use Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## **2.9 SOURCE QUALITY CONTROL**

- A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
  1. Payment for these services will be made by Owner.
  2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- B. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- F. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness

limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### **3.3 LAYING MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

### **3.4 MORTAR BEDDING AND JOINTING**

- A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

### **3.5 MASONRY JOINT REINFORCEMENT**

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  1. Space reinforcement not more than 16 inches o.c.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### **3.6 CONTROL AND EXPANSION JOINTS**

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
  4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

### **3.7 LINTELS**

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

### **3.8 REINFORCED UNIT MASONRY INSTALLATION**

- A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### **3.9 FIELD QUALITY CONTROL**

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
  - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
  - 1. Payment for these services will be made by Owner.
  - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: As determined by Testing Agency.
- D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

### **3.10 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 3. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### **3.11 MASONRY WASTE DISPOSAL**

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04810

## **SECTION 05310 STEEL DECK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Noncomposite form deck at Trash Transfer Building.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 3 Section "Cast-in-Place Concrete" for concrete fill.
  - 3. Division 9 painting Sections for repair painting of primed deck.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - 1. Power-actuated mechanical fasteners.

#### **1.4 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Steel Deck:
    - a. ASC Profiles, Inc.
    - b. Consolidated Systems, Inc.
    - c. Epic Metals Corporation..
    - d. Nucor Corp.; Vulcraft Division.
    - e. Roof Deck, Inc.
    - f. United Steel Deck, Inc.
    - g. Verco Manufacturing Co.
    - h. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

### **2.2 NONCOMPOSITE FORM DECK**

- A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
  - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G60 (Z180) zinc coating.
  - 2. Profile Depth: 1 inch (25.4mm).
  - 3. Design Uncoated-Steel Thickness: 0.0179 inch (0.45 mm).

4. Span Condition: Triple span or more.
5. Side Laps: Overlapped.

## **2.3 ACCESSORIES**

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Locate deck bundles to prevent overloading of supporting members.
- C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

### **3.3 FLOOR-DECK INSTALLATION**

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
  - 3. Weld Spacing: Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:
  - 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

**3.5 REPAIRS AND PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

## **SECTION 05400 COLD-FORMED METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Exterior load-bearing wall framing.
  - 2. Roof rafter framing.
  - 3. Ceiling joist framing.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
  - 3. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
    - b. Roof Rafter Framing: Horizontal Deflection 1/360 of the horizontally projected span.
    - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
  - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure,

connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. AllSteel Products, Inc.
2. Clark Steel Framing.
3. Dale/Incor.
4. Dietrich Metal Framing; a Worthington Industries Company.
5. Formetal Co. Inc. (The).
6. Innovative Steel Systems.
7. SCAFCO Corporation.
8. Steel Construction Systems.
9. United Metal Products, Inc.

## **2.2 MATERIALS**

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
  2. Coating: G60 (Z180).

## **2.3 LOAD-BEARING WALL FRAMING**

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Minimum Base-Metal Thickness: Matching steel studs.
  2. Flange Width: 1-1/4 inches .
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1-5/8 inches.

## **2.4 ROOF-RAFTER FRAMING**

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch.
  2. Flange Width: 1-5/8 inches, minimum.

## **2.5 CEILING JOIST FRAMING**

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As noted on Drawings.
2. Flange Width: 1-5/8 inches, minimum.

## **2.6 FRAMING ACCESSORIES**

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Joist hangers and end closures.

## **2.7 ANCHORS, CLIPS, AND FASTENERS**

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

## **2.8 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.

## **2.9 FABRICATION**

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  1. Fabricate framing assemblies using jigs or templates.
  2. Cut framing members by sawing or shearing; do not torch cut.
  3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
1. Cut framing members by sawing or shearing; do not torch cut.
  2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### **3.3 LOAD-BEARING WALL INSTALLATION**

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
1. Anchor Spacing: 24 inches.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
1. Stud Spacing: 16 inches.

- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.
  - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### **3.4 JOIST INSTALLATION**

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
  - 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.6 REPAIRS AND PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

## **SECTION 05500 METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Miscellaneous structural steel tubes, angles, angles with welded steel plates.
  - 2. Loose bearing and leveling plates.
  - 3. Steel weld plates and angles for casting into concrete.
  - 4. Steel framing and supports for overhead doors.
  - 5. Steel framing and supports for mechanical and electrical equipment.
  - 6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 7. Metal grating
  - 8. Miscellaneous steel trim including steel edgings and trench edge angles.
  - 9. Metal bollards.
  - 10. Corrugated Metal Wall and Roof Panel
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels installed in masonry.
  - 2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
  - 3. Division 4 Section "Unit Masonry Assemblies" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### **1.4 SUBMITTALS**

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  2. Provide templates for anchors and bolts specified for installation under other Sections.
  3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For professional engineer.

### **1.5 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.2, "Structural Welding Code--Aluminum."
  3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  4. AWS D1.6, "Structural Welding Code--Stainless Steel."

### **1.6 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

### **1.7 COORDINATION**

- A. Coordinate installation of anchorages for metal fabrications. 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 steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

## **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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Products: Subject to compliance with requirements, provide one of the products specified.
  - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

### **2.3 FERROUS METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

### **2.4 FASTENERS**

- A. General: Unless otherwise indicated, provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; 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 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36.
  - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- E. Plain Washers: Round, ASME B18.22.1.
- F. Lock Washers: Helical, spring type, ASME B18.21.1.
- G. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- H. Expansion Anchors: Anchor bolt and sleeve assembly 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 according to ASTM E 488, conducted by a qualified independent testing agency.
- I. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 1. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

## **2.5 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with low VOC content.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
1. Use primer with low VOC content.
  2. Products:
    - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
    - b. ICI Devco Coatings; Catha-Coat 313.
    - c. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
    - d. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
    - e. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- G. 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.

## **2.6 FABRICATION, GENERAL**

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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 metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with 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.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

## **2.7 MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## **2.8 LOOSE STEEL LINTELS**

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

**2.9 LOOSE BEARING AND LEVELING PLATES**

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates after fabrication.
- C. Prime plates with zinc-rich primer.

**2.10 STEEL WELD PLATES AND ANGLES**

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

**2.11 METAL BOLLARDS**

- A. Fabricate metal bollards from 1/4-inch wall-thickness steel shapes, as indicated.
  - 1. Cap bollards with 1/4-inch- thick steel plate.
- B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all 4 corners for 3/4-inch anchor bolts.

Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

**2.12 METAL FLOOR PLATE**

- A. Fabricate from rolled-steel floor plate of thickness indicated below:
  - 1. Thickness: As indicated.

**2.13 CORRUGATED METAL WALL AND ROOF PANELS**

- A. Provide corrugated metal wall and roof panels at Trash Transfer Building Control Room.
  - 1. 2-1/2" x 1/2" corrugated panels, width and length as required for installation, 26 gauge, G-90 galvanized sheet steel.

**2.14 FINISHES, GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

## **2.15 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. ASTM A 123/A 123M, for galvanizing steel and iron products.
  2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors SSPC Zone 1B and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. 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. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. 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 surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: 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.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. **Fastening to In-Place Construction:** Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. **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 MISCELLANEOUS FRAMING AND SUPPORTS**

- A. **General:** Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

### **3.3 INSTALLING BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
  2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### **3.4 INSTALLING METAL BOLLARDS**

- A. Anchor bollards in concrete as noted. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

### **3.5 INSTALLING CORRUGATED METAL WALL AND ROOF PANELS**

- A. Install on metal stud framing, with minimum panels laps as recommended by manufacturer and screw attached. Install in sheet widths and lengths as required by design.

### **3.6 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded 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 dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

## **SECTION 05530 GRATINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Metal bar gratings.
  - 2. Metal frames and supports for gratings.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance of Gratings: Provide gratings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
  - 2. Limit deflection to  $L/240$  or 1/4 inch, whichever is less.

#### **1.4 SUBMITTALS**

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Provide templates for anchors and bolts specified for installation under other Sections.
  - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding certificates.
- C. Qualification Data: For professional engineer.

#### **1.5 QUALITY ASSURANCE**

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

## 1.7 COORDINATION

- A. 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Metal Bar Gratings:
    - a. All American Grating, Inc.
    - b. Barnett/Bates Corp.
    - c. Borden Metal Products (Canada) Limited.
    - d. Grupo Metelmex, S.A. de C.V.
    - e. IKG Industries; a Harsco Company.
    - f. Ohio Gratings, Inc.
    - g. Tru-Weld.

## **2.2 FERROUS METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Galvanized Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

## **2.3 FASTENERS**

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A); with hex nuts, ASTM A 563; 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 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- D. Plain Washers: Round, ASME B18.22.1.
- E. Lock Washers: Helical, spring type, ASME B18.21.1.
- F. Anchors: Provide cast-in-place anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
  - 1. Material for Anchors : Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

## **2.4 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. 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, 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: 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.

## 2.6 METAL BAR GRATINGS

- A. Welded Steel Grating :
  - 1. Bearing Bar Depth 1-1/4 inches; Bearing Bar Thickness: 3/8 inch.
  - 2. Crossbar Spacing: 4 inches o.c.
  - 3. Grating Mark: As indicated.
  - 4. Traffic Surface: Serrated.
  - 5. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.
- B. 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 not less than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
  - 2. Provide not less than 4 saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over 2 bearing bars.
  - 3. Provide not less than 4 weld lugs for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch (24 mm) o.c., with each lug shop welded to 3 or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
  - 4. Provide not less 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.

- C. 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.
- D. Do not notch bearing bars at supports to maintain elevation.

## **2.7 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 o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

## **2.8 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: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with ASTM A 123/A 123M.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. 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.
- B. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.
- C. 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.

- D. Field Welding: 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.
- E. 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 ADJUSTING AND CLEANING**

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05530

## **SECTION 06105 MISCELLANEOUS CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Framing with dimension lumber if used.
  - 2. Plywood 5/8" rated plywood sheathing.
  - 3. Wood furring and blocking.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Fire Retardant Treatment: Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

### **PART 2 - PRODUCTS**

#### **2.1 WOOD PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.

## **2.2 FIRE-RETARDANT-TREATED MATERIALS**

- A. General: Comply with performance requirements AWWA C27 (plywood).
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat plywood indicated on Drawings.

## **2.3 DIMENSION LUMBER FRAMING (If Used by Contractor on this Project)**

- A. Maximum Moisture Content: 19 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
- B. Framing: Construction or No. 2 grade and any of the following species:
  - 1. Southern pine; SPIB.
  - 2. Douglas fir-south; WWPA.
  - 3. Hem-fir; WCLIB or WWPA.

## **2.4 MISCELLANEOUS LUMBER**

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Furring.
  - 4. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For exposed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
  - 1. Southern Pine; SPIB.
  - 2. Hem-fir or hem-fir (north); WCLIB, or WWPA.

3. Spruce-pine-fir (south) or spruce-pine-fir; WCLIB, or WWPA.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## **2.5 PLYWOOD SHEATHING**

- A. Plywood Sheathing: DOC PS 1, Structural I sheathing, C-D, fire-retardant treated, in thickness indicated.

## **2.6 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1.

## **2.7 MISCELLANEOUS MATERIALS**

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
  - 4. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.
  - 5. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings..

### **3.2 WOOD BLOCKING, AND NAILER INSTALLATION**

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

### **3.3 PROTECTION**

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06105

## **SECTION 06402 INTERIOR ARCHITECTURAL WOODWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Plastic-laminate countertops for work of Alternate No.3 and Alternate No.4.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

#### **1.3 SUBMITTALS**

- A. Product Data: For high-pressure decorative laminate and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
- C. Samples for Initial Selection:

1. Plastic laminates.

D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Manufacturers' product data for installation adhesives, including printed statement of VOC content.

**1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

**1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**1.7 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other

Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Particleboard: ANSI A208.1, Industrial Grade M-2-Exterior Glue.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Manufacturers: Subject to compliance with requirements, provide manufacturers high-pressure decorative laminates by any one of the following:
    - a. Formica Corporation.
    - b. Nevamar Company, LLC; Decorative Products Div.
    - c. Wilsonart International; Div. of Premark International, Inc.

### **2.2 MISCELLANEOUS MATERIALS**

- A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- B. Adhesive: Do not use adhesives that contain urea formaldehyde.
  - 1. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Wood Glues: 30 g/L.
    - b. Contact Adhesive: 250 g/L.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement
  - 1. Adhesive for Bonding Edges: Hot-melt.

### **2.3 FABRICATION, GENERAL**

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated.
- D. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Shop-cut openings to maximum extent possible to receive plumbing fixtures, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.

### **2.4 PLASTIC-LAMINATE COUNTERTOPS**

- A. Grade: Custom.
- B. High-Pressure Decorative Laminate Grade: HGS.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As indicated by manufacturer's designations.
  - 2. Match Architect's sample.
    - a. Solid colors, matte finish or patterns.
- D. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- E. Core Material: Particleboard.
- F. Core Material at Sinks: Particleboard made with exterior glue.
- G. Paper Backing: Provide paper backing on underside of countertop substrate.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### **3.2 INSTALLATION**

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 3. Secure backsplashes to walls with adhesive.
  - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

### **3.3 ADJUSTING AND CLEANING**

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06402

## **SECTION 07210 BUILDING INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Perimeter insulation under slabs-on-grade.
  - 2. Batt insulation at metal studs
  - 3. Acoustical insulation at metal studs
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 15 Section "Mechanical Insulation."

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

### **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 manufacturers specified.

## **2.2 FOAM-PLASTIC BOARD INSULATION**

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
  - 1. Manufacturers:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company.
    - c. Owens Corning.
    - d. Pactiv Building Products Division.
  - 2. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.
  - 3. Provide at all new foundation walls and grade beams.

## **2.3 GLASS-FIBER BLANKET INSULATION**

- A. Manufacturers:
  - 1. CertainTeed Corporation.
  - 2. Guardian Fiberglass, Inc.
  - 3. Johns Manville.
  - 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less).
- D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
  - 1. 3-5/8 inches thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F.

- E. Acoustical Insulation: ASTM C665, Type 1 (blankets without membrane facing) produced by combining thermosetting resins with mineral-fibers manufactured from glass, slag wool, or rock wool.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean substrates of substances harmful to insulation, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

### **3.3 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

### **3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION**

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

### **3.5 INSTALLATION OF GENERAL BUILDING INSULATION**

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
  - 2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

### **3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION**

- A. Install 3-5/8 inch thick, unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches on either side of partition.

### **3.7 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

## **SECTION 07920 JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes joint sealants for the following applications:
  - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Joints between plant-precast architectural concrete units.
    - c. Control and expansion joints in unit masonry.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    - f. Other joints as indicated.
  - 2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Vertical joints on exposed surfaces of interior unit masonry, concrete and walls.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and louvers.
    - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - g. Other joints as indicated.
  - 3. Interior joints in the following horizontal traffic surfaces:
    - a. Isolation joints in cast-in-place concrete slabs.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.

2. Division 2 Section "Pavement Joint Sealants" for sealing joints in pavements and walkways.
3. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Division 9 Section "Ceramic Tile" for sealing tile joints.

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

### **1.4 SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- F. Warranties: Special warranties specified in this Section.

### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

### **1.6 PROJECT CONDITIONS**

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## **1.7 WARRANTY**

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Two years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  1. Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### **2.2 ELASTOMERIC JOINT SEALANTS**

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- C. Single-Component Nonsag Polysulfide Sealant [**ES**-<#>]:
1. Products:
    - a. Pacific Polymers, Inc.; Elastoseal 230 Type I (Gun Grade).
    - b. Polymeric Systems Inc.; PSI-7000.
    - c. Schnee-Morehead, Inc; Permathane SM7 100.
    - d. Sika Corporation, Inc; Sikaflex 15 Lmg.
    - e. Tremco; Vulkem 921.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

## 2.3 PREFORMED TAPE SEALANTS

- A. Back-Bedding Mastic Tape Sealant: Preformed, butyl-based elastomeric tape sealant with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Tape Sealant: Closed-cell, PVC foam tape sealant; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for applications in which tape acts as the primary sealant.
  2. Type 2, for applications in which tape is used in combination with a full bead of liquid sealant.

## 2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## **2.5 MISCELLANEOUS MATERIALS**

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer),

old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates as recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.3 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

- D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
  4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
  5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
  6. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

### **3.4 CLEANING**

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### **3.5 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07920

## **SECTION 08111 STANDARD STEEL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Standard hollow-metal steel doors.
  - 2. Standard hollow-metal steel frames.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting standard steel frames in masonry construction.
  - 3. Division 8 Sections for door hardware for standard steel doors.
  - 4. Division 9 painting Sections for field painting standard steel doors and frames..

#### **1.3 SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, and finishes for each type of steel door and frame specified.
- B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details.
  - 3. Frame details for each frame type, including dimensioned profiles.
  - 4. Details and locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.
  6. Details of anchorages, accessories, joints, and connections.
- C. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
  1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

#### **1.5 PROJECT CONDITIONS**

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

#### **1.6 COORDINATION**

- A. Coordinate installation of anchorages for standard steel frames. 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 masonry. Deliver such items to Project site in time for installation.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

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

1. Amweld Building Products, LLC.
2. Ceco Door Products; an ASSA ABLOY Group Company.
3. CURRIES Company; an ASSA ABLOY Group Company.
4. Pioneer Industries, Inc.
5. Republic Builders Products Company.
6. Steelcraft; an Ingersoll-Rand Company.

## **2.2 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.
- D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-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 standard steel door frames of type indicated.
- G. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## **2.3 STANDARD STEEL DOORS**

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
  1. Design: Flush panel.

2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8..
  3. Vertical Edges for Single-Acting Doors: Beveled edge.
    - a. Beveled Edge: 1/8 inch in 2 inches.
  4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
  5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick end closures or channels of same material as face sheets.
  6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B Heavy Duty), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 1 and Physical Performance Level C, (Standard Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  3. Lock Face Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
  4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
  - 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
  - 2. Frames for Level 2 Steel Doors: 0.053-inch thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
  - 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
  - 2. Frames for Level 1 Steel Doors: 0.042-inch thick steel sheet.
  - 3. Frames for Level 2 Steel Doors: 0.053-inch thick steel sheet.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
  - 1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  - 2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  - 3. Lock Face: Closers, and Concealed Holders: Minimum 0.067 inch thick.
  - 4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- F. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

- I. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch wide steel.
- J. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick.

## 2.5 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
  - 3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in masonry.
  - 4. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
  - 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  - 6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - b. Three anchors per jamb from 60 to 90 inches in height.
      - c. Four anchors per jamb from 90 to 120 inches in height.
  - 7. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - a. Four anchors per jamb from 60 to 90 inches in height.
    - b. Five anchors per jamb from 90 to 96 inches in height.

- c. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
  - 8. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  - 9. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
  - 1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
  - 2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

## **2.6 STEEL FINISHES**

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish standard steel door and frames after assembly.
- B. Metallic-Coated Steel Surface Preparation: 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. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from

uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

## **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 standard steel doors and frames.
  - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Standard Steel Frames: Install standard steel frames for doors, sidelights and borrowed lights and other openings, of size and profile indicated. Comply with SDI 105.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install door silencers in frames before grouting.
    - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - d. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - e. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
  - 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

6. In-Place Precast Concrete and Metal Building Walls: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
  8. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

### **3.4 ADJUSTING AND CLEANING**

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
  
- D. Galvanized Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08111

## **SECTION 08211 FLUSH WOOD DOORS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Solid-core doors with wood-veneer, faces.
  - 2. Factory finishing flush wood doors.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building.
  - 2. Section 08110 "Steel Doors and Frames" for wood door frames.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications. Include data and compliance for fire rated label.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  - 1. Indicate dimensions and locations of mortises and holes for hardware.
  - 2. Indicate dimensions and locations of cutouts.
  - 3. Indicate requirements for veneer matching.
  - 4. Indicate doors to be factory finished and finish requirements.
  - 5. Indicate fire ratings for fire doors.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
  - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  - 1. Test Pressure: Test at atmospheric pressure.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

### **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

### **1.7 WARRANTY**

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-inch by 84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:

- a. Solid-Core Interior Doors: Life of installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flush Wood Doors:
    - a. Algoma Hardwoods Inc.
    - b. Buell Door Company.
    - c. Eggers Industries; Architectural Door Division.
    - d. Marshfield Door Systems, Inc.

### **2.2 DOOR CONSTRUCTION, GENERAL**

- A. Doors for Opaque Finish:
  1. Grade: Premium.
  2. Faces for Interior Doors: Medium-density overlay or Any closed-grain hardwood of mill option.
  3. Apply medium-density overlay to standard thickness, closed-grain, hardwood face veneers.

### **2.3 SOLID-CORE DOORS**

- A. Particleboard Cores: Comply with the following requirements:
  1. Particleboard: ANSI A208.1, Grade LD-1.
  2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
  3. Provide doors with glued-block cores instead of particleboard cores at locations where exit devices are indicated.
- B. Interior Veneer-Faced Doors:
  1. Core: Particleboard.

2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

## **2.4 FABRICATION**

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
  1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
  1. Light Openings: Trim openings with moldings of material and profile indicated.

## **2.5 FACTORY FINISHING**

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Finish doors at site.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine doors and installed door frames before hanging doors.
  1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Hardware: For installation, see Section 08710 "Hardware."
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

### **3.3 ADJUSTING**

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

## **SECTION 08361 SECTIONAL OVERHEAD DOORS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following types of sectional overhead doors:
  - 1. Doors with steel-framed steel panels.
  - 2. Tracks configured for the following lift types:
    - a. Standard.
- B. Related Sections include the following:
  - 1. Section 09912 "Exterior Painting" for field-applied paint finish.
  - 2. Division 16 for electrical service and connections for powered operators, and accessories.

#### **1.3 DEFINITIONS**

- A. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
  - 1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft., acting inward and outward.
- B. Operation-Cycle Requirements: Design sectional overhead door components and operator to operate for not less than 10,000 cycles.

#### **1.5 SUBMITTALS**

- A. **Product Data:** For each type and size of sectional overhead door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
  - 1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.
  - 2. Summary of forces and loads on walls and jambs.
  - 3. **Motors:** Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
- B. **Shop Drawings:** For special components and installations not dimensioned or detailed in manufacturer's data sheets.
  - 1. **Wiring Diagrams:** Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.

## **1.6 QUALITY ASSURANCE**

- A. **Installer Qualifications:** Engage an experienced installer who is an authorized representative of the sectional overhead door manufacturer for both installation and maintenance of units required for this Project.
- B. **Manufacturer Qualifications:** Engage a firm experienced in manufacturing sectional overhead doors similar to those indicated for this Project and with a record of successful in-service performance.
- C. **Source Limitations:** Obtain sectional overhead doors through one source from a single manufacturer.
  - 1. Obtain operators and controls from the sectional overhead door manufacturer.
- D. **Warranty Period:** One (1) year for defective materials and workmanship. Five (5) years for finish against rust. Five (5) years for electric operators.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. **Manufacturer:** Subject to compliance with requirements, provide products by one of the following:

1. Basis-Of-Design: Clopay Pro-Series, Model 3720 by Clopay Building Products.
2. Overhead Door Corporation.

## 2.2 STEEL SECTIONS

- A. Construct door sections from galvanized, structural-quality carbon-steel sheets complying with ASTM A 653 (ASTM A 653M), commercial quality, with a minimum yield strength of 33,000 psi and a minimum G60 zinc coating.
  1. Steel Sheet Thickness: 0.016 inch.
  2. Exterior Section Face: Ribbed, textured.
  3. Steel Sheet Inside Face: 0.016 inch thick.
- B. Fabricate door panels from a single sheet to provide sections not more than 24 inches high and nominally 2 inches deep. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
  1. For insulated doors, provide door sections with continuous thermal-break construction, separating faces of door.
- C. Enclose open section with not less than 0.064-inch galvanized steel channel end stiles welded in place. Provide not less than 0.064-inch galvanized intermediate stiles, cut to door section profile, spaced at not more than 48 inches on center, and welded in place.
- D. Reinforce bottom section with a continuous channel or angle complying with bottom section profile and allowing installation of astragal.
- E. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses or strip steel, formed to depth and bolted or welded in place.
- F. Provide reinforcement for hardware attachment.
- G. Insulation: Manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation, foamed in place to completely fill inner core of section, pressure bonded to face sheets to prevent delamination under wind load and with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely, with no exposed insulation material evident. (Contractor Option)

- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints, and free of warp, twist, and deformation.
- I. Finish galvanized steel door sections as follows:
  - 1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 2. Surface Preparation: Clean galvanized surfaces with nonpetroleum solvent so surfaces are free of oil and surface contaminants.
  - 3. Apply manufacturer's standard primer to both door faces after forming, according to coating manufacturer's written instructions for application and minimum dry film thickness.

### **2.3 TRACKS, SUPPORTS, AND ACCESSORIES**

- A. Tracks: Provide manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, and complying with ASTM A 653, for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track at 2 inches on center for door-drop safety device. Slope tracks at proper angle from vertical or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.
- B. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members, complying with ASTM A 36 and ASTM A 123. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- C. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling) tracks with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks.
- D. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and at top of overhead door.
  - 1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
  - 2. In addition, provide continuous flexible seals at door jambs for a weathertight installation.

## **2.4 HARDWARE**

- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Provide heavy-duty galvanized steel hinges, of not less than 0.0747-inch-thick uncoated steel, at each end stile and at each intermediate stile, per manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.
- C. Rollers: Provide heavy-duty rollers, with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch-diameter roller tires for 3-inch track, 2-inch-diameter roller tires for 2-inch track, and as follows:
  - 1. Case-hardened steel tires.

## **2.5 COUNTERBALANCING MECHANISM**

- A. Torsion Spring: Operation by torsion-spring counterbalance mechanism consisting of adjustable-tension torsion springs, fabricated from oil-tempered-steel wire complying with ASTM A 229, Class II, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for 10,000 cycles minimum.
- B. Bracket: Provide anchor support bracket, as required to connect stationary end of spring to the wall, to level shaft and prevent sag.
- C. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

## **2.6 ELECTRIC DOOR OPERATORS**

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, complete with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Comply with NFPA 70.

- C. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, AC or DC.
- F. Door-Operator Type: Provide unit consisting of electric motor and the following:
  - 1. Manufacturers standard for door specified.
- G. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or considering service factor. Sallyport doors to be interlocked to allow only one (1) door to be open at a time, coordinate with Division 17.
- H. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
  - 1. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Provide electrically actuated automatic bottom bar.
      - (1) Self-Monitoring Type: Provide self-monitoring, 4-wire configured device.
- I. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- J. Special Control: Card reader control system, see Section 17900 "Security Electronics General Provisions" for controls (sallyport doors only).

- K. Remote-Control Station: Provide momentary-contact, 3-button control station with push button controls labeled "Open," "Close," and "Stop" (vehicle processing door only).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine wall and overhead areas, including opening framing and blocking, with Installer present, for compliance with requirements for installation tolerances, clearances, and other conditions affecting performance of Work of this Section.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
- B. Fasten vertical track assembly to framing at not less than 24 inches on center. Hang horizontal track from structural overhead framing with angle or channel hangers welded and bolt fastened in place. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

### **3.3 ADJUSTING**

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

### **3.4 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

3. Review data in the maintenance manuals. Refer to Section 01770 "Closeout Procedures."
4. Schedule training with Owner with at least seven (7) days' advance notice.

END OF SECTION 08361

## **SECTION 08410 ALUMINUM STOREFRONTS SYSTEMS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Interior storefront window.
- B. Related sections include the following:
  - 1. Division 1 Section "Alternates" for work at the Trash Transfer Building.
  - 2. Division 8 Section 08800 "Glazing."
- C. Aluminum storefront is required at:
  - 1. Trash Transfer Building.

#### **1.3 SUBMITTALS**

- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
- C. Samples for Verification: Of each type of exposed finish required in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.
- B. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific system indicated.

Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section 01600 "Product Requirements."

1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

## **1.5 PROJECT CONDITIONS**

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Basis for design "Kawneer 451."
  1. EFCO Corporation.
  2. Kawneer Company, Inc.
  3. Tubelite Architectural Systems.

### **2.2 MATERIALS**

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
  1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
  3. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
- B. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- C. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- D. Structural Silicone Sealant: Type recommended by sealant and system manufacturers that complies with ASTM C 1184 requirements, is compatible with system components with which it comes in contact, and is specifically formulated and tested for use as a structural sealant.

1. Color: As selected by Architect from manufacturer's full range of colors.
  2. Tensile Strength: 100 psi minimum.
  3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by structural-sealant-glazed systems' design.
  4. Use neutral-cure silicone sealant with insulating-glass units.
- E. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.
1. Color: As selected by Architect from manufacturer's full range of colors.
  2. Use neutral-cure silicone sealant with insulating-glass units.
- F. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

## 2.3 COMPONENTS

- A. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Reinforce members as required to retain fastener threads.
  2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.

## 2.4 FABRICATION

- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

- E. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- F. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- G. Storefront: Fabricate framing in profiles indicated. Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

## **2.5 ALUMINUM FINISHES**

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in aluminum pieces 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.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. 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 607.1.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

- D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Division 7 Section 07920 "Joint Sealants."
- E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- F. Install perimeter sealant to comply with requirements of Division 7 Section 07920 "Joint Sealants," unless otherwise indicated.
- G. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
  - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
  - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
  - 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

### **3.3 ADJUSTING AND CLEANING**

- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

### **3.4 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08410

## **SECTION 08800 GLAZING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes glazing for the following applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Interior Aluminum Storefront Borrowed Lite.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 8 Section "Aluminum Storefronts"

#### **1.3 DEFINITIONS**

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions.

#### **1.5 SUBMITTALS**

- A. Product Data: For each glass product and glazing material indicated.

- B. Samples: For the following products, in the form of 12-inch square Samples for glass and of 12-inch long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- D. Product Test Reports: For each of the types of glazing products:
  - 1. Insulating glass.
- E. Warranties: Special warranties specified in this Section.

## **1.6 QUALITY ASSURANCE**

- A. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass and insulating glass.
- B. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- C. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
  - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of manufacturer acceptable to authorities having jurisdiction.
- D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
  - 2. GANA Publications: GANA's "Glazing Manual".
- E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
  - 1. Insulating Glass Certification Council.
  - 2. Associated Laboratories, Inc.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

## 1.8 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS

- A. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
  - 1. Outdoor Lite: Class 1 (clear) float glass or tempered glass as indicated.  
Indoor Lite: Class 1 (clear) float glass.
  - 2. Products:
    - a). Guardian Glass,
    - b). Pilkington Building Products North America.
    - c). PPG Industries, Inc.
  - 3. Sealing System: Dual seal, with primary and secondary sealants as follows:
    - a. Manufacturer's standard sealants.
  - 4. Spacer Specifications: Manufacturer's standard spacer material and construction.

### 2.2 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
  - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range].
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Single-Component Neutral-Curing Silicone Glazing Sealants:
    - a. Products:
      - 1). Dow Corning Corporation; 790.
      - 2). GE Silicones; SilPruf LM SCS2700.
      - 3). Tremco; Spectrem 1 (Basic).
      - 4). Pecora Corporation; 864.
      - 5). Pecora Corporation; 890.
      - 6). Sonneborn, Div. of ChemRex, Inc.; Omniseal.
    - b. Type and Grade: S (single component) and NS (nonsag).
    - c. Class: 50.
    - d. Use Related to Exposure: NT (nontraffic).
    - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

## 2.3 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.

## 2.4 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

## **2.5 FABRICATION OF GLAZING UNITS**

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## **PART 1 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine framing glazing, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Minimum required face or edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

### **3.3 GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged

glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

### **3.4 TAPE GLAZING**

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.

- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### **3.5 SEALANT GLAZING (WET)**

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### **3.6 CLEANING AND PROTECTION**

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08800

## **SECTION 09260 GYPSUM BOARD ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Interior gypsum wallboard.
  - 2. Tile backing panels.
  - 3. Non-load-bearing steel framing.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
  - 2. Division 6 Section "Rough Carpentry" for wood framing and furring.
  - 3. Division 7 Section "Building Insulation " for insulation installed in gypsum board assemblies.

#### **1.3 DEFINITIONS**

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size sample in 12-inch long length for each trim accessory indicated.

#### **1.5 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. Stack gypsum panels flat to prevent sagging.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Steel Framing and Furring:
    - a. Clark Steel Framing Systems.
    - b. Dietrich Industries, Inc.
    - c. National Gypsum Company.
    - d. Scafco Corporation.
    - e. Western Metal Lath & Steel Framing System.
  - 2. Gypsum Board and Related Products:
    - a. American Gypsum Co.
    - b. G-P Gypsum Corp.
    - c. National Gypsum Company.
    - e. United States Gypsum Co.

### 2.2 STEEL SUSPENDED CEILING FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
- C. Hanger Attachments: As follows:
  - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining,

without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.

2. Type: Postinstalled, expansion anchor.
3. 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 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

D. Hangers: As follows:

1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
2. Rod Hangers: ASTM A 510, mild carbon steel.
  - a. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
  - b. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized.
  - c. Angle Hangers: ASTM A 653/A 653M, G60, hot-dip galvanized commercial-steel sheet.
  - d. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch wide flange, with ASTM A 653/A 653M, G40Z1, hot-dip galvanized zinc coating.
  - e. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
3. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange, 3/4 inch deep.

E. Steel Studs: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated.
  - a. Depth: 3-5/8 inches.
2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
  - a. Minimum Base Metal Thickness: 0.0179 inch.

## 2.3 STEEL PARTITION FRAMING

- A. Components, General: As follows:
  - 1. Comply with ASTM C 754 for conditions indicated.
  - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base Metal Thickness: As indicated.
  - 2. Depth: As indicated.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch deep flanges.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base Metal Thickness: 0.0179 inch.
- E. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0179 inch.
  - 2. Depth: As indicated.
- G. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange.
  - 1. Depth: 3/4 inch.
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
- H. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## **2.4 INTERIOR GYPSUM WALLBOARD**

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
  - 1. Regular Type:

- a. Thickness: 1/2 inch for walls or 5/8" for ceilings as noted on Drawings.
- b. Long Edges: Tapered.
- c. Location: As indicated.

## **2.5 TILE BACKING PANELS**

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Cementitious Backer Units: ANSI A118.9.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Wonderboard.
    - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    - c. United States Gypsum Co.; DUROCK Cement Board.
  2. Thickness: 1/2 inch.

## **2.6 TRIM ACCESSORIES**

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet, or rolled zinc.
  2. Shapes:
    - a. Cornerbead: Use at outside corners.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
    - c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
    - d. Expansion (Control) Joint: Use where indicated.

## **2.7 JOINT TREATMENT MATERIALS**

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
  1. Interior Gypsum Wallboard: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints 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 drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound].
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound].

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by manufacturer.

## 2.8 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
  1. Acoustical Sealant for Concealed Joints:
    - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
    - b. Pecora Corp.; BA-98.
    - c. Tremco, Inc.; Tremco Acoustical Sealant.

## 2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. 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 thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Acoustical and Thermal Insulation: As specified in Division 7 Section "Building Insulation."

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

### **3.2 PREPARATION**

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

### **3.3 INSTALLING STEEL FRAMING, GENERAL**

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements 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 gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
  - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
    - a. Use deep-leg deflection track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

### **3.4 INSTALLING STEEL SUSPENDED CEILING**

- A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  4. Secure rod, flat or angle hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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. Attach hangers to structural members.
  6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. Screw furring to wood framing.
- E. Wire-tie furring channels to supports.
- F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels 16 inches **o.c.**

### **3.5 INSTALLING STEEL PARTITION FRAMING**

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install foam-gasket isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

- C. .Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
  - 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
- D. Install steel studs and furring at the following spacings:
  - 1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
  - 2. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
  - 1. Install two studs at each jamb, unless otherwise indicated.
  - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
  - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- G. 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.

### **3.6 APPLYING AND FINISHING PANELS, GENERAL**

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. 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.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Fit gypsum panels around ducts, pipes, and conduits.
  - 2. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
  - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

### **3.7 PANEL APPLICATION METHODS**

- A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the 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.
  3. Stagger abutting end joints not less than one framing member in alternate courses of board.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Tile Backing Panels:
1. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated.
  2. Areas Not Subject to Wetting: Install standard gypsum wallboard panels to produce a flat surface except at showers and other locations indicated to receive water-resistant panels.
  3. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

### **3.8 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 Joints: Install control joints at locations indicated on Drawings and in accordance to ASTM C 840 and in specific locations approved by Architect for visual effect.

### **3.9 FINISHING GYPSUM BOARD ASSEMBLIES**

- 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 beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies.
  2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
  3. Level 3: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

**3.10 FIELD QUALITY CONTROL**

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

END OF SECTION 09260

## **SECTION 09310 CERAMIC TILE**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Ceramic mosaic tile.
  - 2. Crack-suppression membrane for thin-set tile installations.
  - 3. Metal edge strips installed as part of tile installations.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building.
  - 2. Section 03300 "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
  - 3. Section 09260 "Gypsum Board Assemblies" for cementitious backer units.

#### **1.3 DEFINITIONS**

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

#### **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 0.6.

## **1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. 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.
- C. Samples for Verification:
  1. Full-size units of each type and composition of tile and for each color and finish required.
  2. Assembled samples with grouted joints for 12-inch by 12-inch paver tile mounted on rigid panel. 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. Metal edge strips in 6-inch lengths.

## **1.6 QUALITY ASSURANCE**

- A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
  1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single 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 through one source from a single manufacturer for each product:
  1. Joint sealants.
  2. Metal edge strips.

## **1.7 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 requirement in ANSI A137.1 for labeling sealed 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 avoided.
- D. Store liquid latexes and emulsion adhesives 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.

## **1.8 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.

## **1.9 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. 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.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists and on the drawings, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
  - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
  - 1. Match Architect's selections indicated on the drawings, as approved by the Architect.
- D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.
- E. 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.

## 2.3 TILE PRODUCTS

- A. Manufacturers:
  - 1. American Olean; Div. of Dal-Tile International Corp.
  - 2. Crossville Inc.
  - 3. Mannington.
  - 3. Daltile; Div. of Dal-Tile International Inc.
- B. Unglazed Ceramic Mosaic Tile:
  - 1. Composition: Porcelain.

2. Surface: Smooth, without abrasive admixture.
  3. Module Size: 8 inches by 8 inches.
  4. Nominal Thickness: 5/16 inch.
  5. Face: Plain with cushion edges.
  6. Products:
    - a. Crossville Cross Colorado of Crossville Inc.
- C. Unglazed Paver Tile: Flat tile as follows:
1. Composition: Porcelain Impervious natural clay or porcelain.
  2. Module Size: 8 inches by 8 inches.
  3. Thickness: 5/16 inch.
  4. Face: Plain with square or cushion edges.
  5. For latex-Portland cement-mortared and -grouted paver tile, precoat with temporary protective coating.
  6. Products:
    - a. Crossville Cross Colors by Crossville Inc.
- D. Ceramic Mosaic Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
1. Base Cove: Cove, module size 2 inch by 2 inch.
  2. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size 2 inches by 2 inches.
  3. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 2 inches by 2 inches.
  4. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above.
  5. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size 2 inches by 2 inches.

6. Internal Corners: Cove, module size.

## **2.4 CRACK-SUPPRESSION MEMBRANES FOR THIN-SET TILE INSTALLATIONS**

- A. General: Manufacturer's standard product that complies with ANSI A118.10, selected from the following.
- B. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber and fabric reinforcement.
  1. Products:
    - a. Custom Building Products; Trowel & Seal Waterproofing and Anti-Fracture Membrane.
    - b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.
    - c. MAPEI Corporation; PRP M19.
    - d. Summitville Tiles, Inc.

## **2.5 SETTING AND GROUTING MATERIALS**

- A. Manufacturers:
  1. LATICRETE International Inc.
  2. MAPEI Corporation.
  3. Southern Grouts & Mortars, Inc.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
  1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
  2. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.
    - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
- C. Organic Adhesive: ANSI A136.1, Type I.
- D. Polymer-Modified Tile Grout: ANSI A118.7, color as indicated.

1. Polymer Type: Either ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients, or acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
  - a. Unsanded grout mixture for joints 1/8 inch and narrower.
  - b. Sanded grout mixture for joints wider than 1/8 inch.

## **2.6 ELASTOMERIC SEALANTS**

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Section 07920 "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. 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:
    - a. Dow Corning Corporation; Dow Corning 786.
    - b. GE Silicones; Sanitary 1700.
    - c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
    - d. Tremco, Inc.; Tremsil 600 White.

## **2.7 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, white zinc alloy exposed-edge material.
- C. Temporary Protective Coating: Either 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° F to 140° F 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 that does not change color or appearance of grout.

## **2.8 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 oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
  2. 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 before installing tile.
  3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with adhesives or thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
  - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
  - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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: Where 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 INSTALLATION, GENERAL**

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. 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.
- D. 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.

- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. 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.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 07920 "Joint Sealants."
- H. Grout tile to comply with requirements of the following tile installation standards:
  - 1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

### **3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION**

- A. Install crack-suppression membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

### **3.5 FLOOR TILE INSTALLATION**

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
  - 1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.

- a. Tile floors in wet areas.
  - b. Tile floors composed of tiles 8 inches by 8 inches or larger.
- B. Joint Widths: Install tile on floors with the following joint widths:
- 1. Ceramic Mosaic Tile: 1/4 inch.
  - 2. Paver Tile: 1/4 inch.
- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- D. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

### **3.6 WALL TILE INSTALLATION**

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
- 1. Ceramic Mosaic Tile: 1/4 inch.

### **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 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 ten (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 that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven (7) days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

### **3.8 FLOOR TILE INSTALLATION SCHEDULE**

- A. Tile Installation: Interior floor installation on concrete; thin set mortar; TCA F122 and ANSI A108.5.
  - 1. Tile Type: Unglazed ceramic mosaic tile.
  - 2. Thin-Set Mortar: Latex-portland cement mortar.
  - 3. Grout: Polymer-modified sanded grout.
- B. Tile Installation: Interior floor installation on crack-suppression membrane over concrete; thin-set mortar; TCA F122 and ANSI A108.5.
  - 1. Tile Type: Unglazed paver tile.
  - 2. Thin-Set Mortar: Latex-portland cement mortar.
  - 3. Grout: Polymer-modified sanded grout.

### **3.9 WALL TILE INSTALLATION SCHEDULE**

- A. Tile Installation: interior wall installation over sound, dimensionally stable masonry; thin-set mortar; TCA W202 and ANSI A108.5.
  - 1. Tile Type: Unglazed ceramic mosaic tile.
  - 2. Thin-Set Mortar: Latex-portland cement mortar.
  - 3. Grout: Polymer-modified sanded grout..
- B. Tile Installation: Interior wall installation over gypsum board on metal studs; thin-set mortar; TCA W243 and ANSI A108.5.
  - 1. Tile Type: Unglazed ceramic mosaic tile.
  - 2. Thin-Set Mortar: Latex-portland cement mortar.

3. Grout: Polymer-modified sanded grout.
- C. Tile Installation: Interior wall installation over cementitious backer units; thin-set mortar; TCA W244 and ANSI A108.5.
1. Tile Type: Unglazed ceramic mosaic tile.
  2. Thin-Set Mortar: Latex-portland cement mortar.
  3. Grout: Polymer-modified unsanded grout.

END OF SECTION 09310

## **SECTION 09512 ACOUSTICAL TILE CEILINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes acoustical tiles for ceilings and the following:
  - 1. Exposed suspension systems.
  - 2. Acoustical Tile
- B. See Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.

#### **1.3 DEFINITIONS**

- A. CAC: Ceiling Attenuation Class.
- B. LR: Light Reflectance coefficient.
- C. NRC: Noise Reduction Coefficient.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 4. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - 1. Acoustical Tile: Set of 6-inch-square samples of each type, color, pattern, and texture.

2. Exposed Suspension System Members: 12-inch-long Sample of each type.
3. Exposed Moldings and Trim: Set of 12-inch-long Samples of each type and color.

## 1.5 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, as documented according to ASTM E 548. 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:
  1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.
  2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:
  1. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
    - a. Smoke-Developed Index: 450 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, 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 tiles, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile 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 forty-eight (48) hours before beginning acoustical tile ceiling installation.

## **1.8 COORDINATION**

- A. Coordinate layout and installation of acoustical tiles 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.

## **1.9 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. Acoustical Ceiling Units: Full-size units equal to 2 percent of quantity installed.
  2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  1. Products: Subject to compliance with requirements, provide one of the products specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 ACOUSTICAL TILES, GENERAL**

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
  1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

### **2.3 MINERAL-BASE ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING**

- A. Products:

1. Armstrong World Industries: Optima tile.
  2. Chicago Metallic Corporation.
  3. USG Interiors, Inc.
- B. Classification: Provide tiles complying with ASTM E 1264 for Type XII, mineral base with painted finish; Form 2.
1. Pattern: Lightly Textured.
- C. Color: White.
- D. LR: Not less than 0.89.
- E. NRC: Not less than 0.90.
- F. CAC: Not applicable.
- G. Edge Detail: Square Lay-in.
- H. Thickness: 7/8 inch.
- I. Size: 24 inches by 48 inches.

#### **2.4 METAL SUSPENSION SYSTEMS, GENERAL**

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- 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. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

#### **2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING**

- A. Products:
1. Armstrong World Industries: 15/16" Exposed Face
  2. Chicago Metallic Corporation.
  3. USG Interiors, Inc.

- B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytic zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 coating designation.
  - 1. Structural Classification: Intermediate-duty system.

## **2.6 METAL EDGE MOLDINGS AND TRIM**

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc.
  - 2. Chicago Metallic Corporation.
  - 3. USG Interiors, Inc.
- 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 fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
  - 1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile 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 tile 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 tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

### **3.3 INSTALLATION, SUSPENDED ACOUSTICAL TILE CEILINGS**

- A. General: Install acoustical tile ceilings to comply with ASTM C 636 and seismic requirements 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three (3) 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. Space hangers not more than 48 inches on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.
1. Screw attach moldings to substrate at intervals not more than 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  2. 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. Arrange directionally patterned acoustical tiles as follows:
1. As indicated on reflected ceiling plans.
- G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim.
1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.

### **3.4 CLEANING**

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09512

## **SECTION 09651 RESILIENT FLOOR TILE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Vinyl composition tile (VCT)
- B. Related Sections including the following:
  - 1. Division 1 Section "Alternates" for work of Alternates No.3.
  - 2. Division 9 Section "Resilient Wall Base" for resilient wall base, reducer strips, and other accessories installed with resilient floor tile.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

#### **1.5 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 or more than 90 deg F. Store tiles on flat surfaces.

## **1.6 PROJECT CONDITIONS**

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

## **1.7 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. Floor Tile: Furnish 1 box of each type, color, and pattern of floor tile installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### **2.2 COLORS AND PATTERNS**

- A. Colors and Patterns: As selected by Architect from manufacturer's full range.

### **2.3 VINYL COMPOSITION TILE**

- A. Vinyl Composition Tile (VCT): ASTM F 1066.
  - 1. Armstrong World Industries, Inc.

2. Azrock Commercial Flooring, DOMCO.
  3. Congoleum Corporation.
  4. Tarkett Inc.
- B. Class: 2 (through-pattern tile).
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Fire-Test-Response Characteristics:
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

## **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 resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT Tile Adhesives: 50 g/L.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
1. 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.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 3. Moisture 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. in 24 hours.
    - b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. 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.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. 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. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 TILE INSTALLATION**

- A. Lay out 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.
- B. Match 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.

- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including pipes, outlets, edgings, door frames, and thresholds.
- D. Extend tiles into door reveals and similar openings.
- E. 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.
- F. Adhere 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.

### **3.4 CLEANING AND PROTECTION**

- A. 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.
    - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
  - 1. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
  - 2. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09651

## **SECTION 09653 RESILIENT WALL BASE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Wall base.
- B. Related Work In Other Sections
  - 1. Division 1 Section "Alternates" for work of Alternates No.3 and No.4.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

#### **1.4 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 or more than 90 deg F.

#### **1.5 PROJECT CONDITIONS**

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

## **1.6 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. Furnish ten lineal feet of type, color, pattern, and size of resilient product installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### **2.2 COLORS AND PATTERNS**

- A. Colors and Patterns: As selected by Architect from manufacturer's full range.

### **2.3 RUBBER WALL BASE**

- A. Wall Base: ASTM F 1861.
  - 1. Armstrong World Industries, Inc.
  - 2. Azrock Commercial Flooring, DOMCO.
  - 3. Burke Mercer Flooring Products.
  - 4. Johnsonite.
  - 5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
  - 6. Roppe Corporation.
  - 7. VPI, LLC, Floor Products Division.
- B. Type (Material Requirement) TS rubber, vulcanized thermoset.
- C. Group (Manufacturing Method): I solid, homogeneous.
- D. Style: Cove with top-set toe for hard surfaces.
- E. Minimum Thickness: 0.125 inch.
- F. Height: 4 inches.
- G. Outside Corners: Premolded.
- H. Inside Corners: Job formed.
- I. Surface: Smooth.

## **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 resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Cove Base Adhesives: 50 g/L.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
  - 1. 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.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. 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.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 BASE INSTALLATION**

- A. Apply wall base to walls, columns, and pilasters where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. Premolded Corners: Install premolded outside-corners before installing straight pieces.
- F. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

### **3.4 CLEANING AND PROTECTION**

- A. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
    - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09653

## **SECTION 09912 PAINTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
  - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
  - 1. Prefinished items include the following factory-finished components:
    - a. Architectural woodwork.
    - b. Acoustical ceiling panels.
    - c. Metal toilet enclosures.
    - d. Finished mechanical and electrical equipment.
    - e. Light fixtures.
  - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Duct shafts.
  - 3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel.
    - c. Chromium plate.

4. Exposed bare and covered pipes and ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment. that do not have a factory-applied final finish.
5. Operating parts include moving parts of operating equipment.
6. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

1. Division 1 Section "Alternates" for work at Fleet Maintenance Building and Trash Transfer Building.
2. Division 2 Section "Hot-Mix Asphalt Paving" for traffic-marking paint.
3. Division 2 Section "Cement Concrete Pavement" for traffic-marking paint.
4. Division 3 Section "Architectural Precast Concrete" is prefinished.
5. Division 13 Section "Metal Building Systems" is prefinished.

### 1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

### 1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. 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.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After color selection, Architect will furnish color chips for surfaces to be coated.

- C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
  - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
  - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
  - 3. Submit two samples on the following substrates for Architect's review of color and texture only:
    - a. Concrete: 4-inch Samples for each color and finish.
    - b. Concrete Unit Masonry: 4-inch Samples of masonry, with mortar joint in the center, for each finish and color.
    - c. Painted Wood: 8-inch- square Samples for each color and material on hardboard.
    - d. Ferrous Metal: 4-inch-square Samples of flat and solid metal for each color and finish.

## 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
  - 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
  - 2. Final approval of colors will be from benchmark samples.

## 1.6 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. Contents by volume, for pigment and vehicle constituents.
  - 4. Application instructions.
  - 5. Color name and number.
  - 6. VOC content.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
  - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

## 1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- D. 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.

## 1.8 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.
  - 1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
    - a. Exterior, Semigloss Acrylic Enamel: One of each color applied.
    - b. Exterior, Full-Gloss Alkyd Enamel: One of each color applied.
    - c. Interior, Semigloss Acrylic Enamel: One case of each color applied.
    - d. Interior, Full-Gloss Alkyd Enamel: One case each color required.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Benjamin Moore & Co. (Benjamin Moore).

2. ICI Dulux Paint Centers (ICI Dulux Paints).
3. Kwal Paint Co. (Kwal)
4. PPG Industries, Inc. (Pittsburgh Paints).
5. Sherwin-Williams Co. (Sherwin-Williams).

## 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
  1. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
  2. Anticorrosive Coatings: VOC content of not more than 250 g/L.
  3. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.
    - j. 1,2-dichlorobenzene.
    - k. Diethyl phthalate.
    - l. Dimethyl phthalate.
    - m. Ethylbenzene.
    - n. Formaldehyde.
    - o. Hexavalent chromium.
    - p. Isophorone.
    - q. Lead.
    - r. Mercury.
    - s. Methyl ethyl ketone.
    - t. Methyl isobutyl ketone.

- u. Methylene chloride.
- w. Naphthalene.
- x. Toluene (methylbenzene).
- y. 1,1,1-trichloroethane.
- z. Vinyl chloride.

D. Colors: As selected by Architect from manufacturer's full range.

### **2.3 CONCRETE UNIT MASONRY BLOCK FILLERS**

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers for all new block masonry.

1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285.
2. Benjamin Moore; Moore's IMC Latex Block Filler No. M88. Applied
3. ICI Dulux Paints; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler.
4. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler.
5. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25.

### **2.4 EXTERIOR PRIMERS**

A. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application for all exposed new and existing concrete walls (do not paint horizontal slabs) and masonry.

1. Benjamin Moore; Moore's Acrylic Masonry Sealer No. 066.
2. Benjamin Moore; Moore's Alkyd Masonry Sealer No. 077.
3. ICI Dulux Paints; 2000-1200 Dulux Professional Exterior 100 Percent Acrylic Latex Primer.
4. Pittsburgh Paints; 6-603 SpeedHide Interior/Exterior Acrylic Latex Alkali Resistant Primer.
5. Sherwin-Williams; Loxon Exterior Masonry Acrylic Primer A24W300.
6. Sherwin-Williams; A-100 Latex Exterior Wood Primer B42W41.

B. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application for all new and existing louvers, doors and door frames.

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06.
2. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer.
3. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.
4. Sherwin-Williams; Kem Kromik Universal Metal .

C. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04.
2. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish.

3. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer.
4. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
5. Sherwin-Williams; primer not required over this substrate.
6. Sherwin-Williams; Galvite HS Paint B50WZ3.

## 2.5 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for all exposed new and existing concrete walls (do not paint horizontal slabs) and masonry.
  1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253.
  2. ICI Dulux Paints; 3030-1200 Bond-Prep Interior/Exterior Waterborne Pigmented Bonding Primer.
  3. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer.
  4. Sherwin-Williams; PrepRite Masonry Primer B28W300.
- B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
  1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253.
  2. ICI Dulux Paints; 1000-1200 Dulux Ultra Basecoat Interior Latex Wall Primer.
  3. ICI Dulux Paints; 1030-1200 Ultra-Hide PVA Interior Primer Sealer General Purpose Wall Primer.
  4. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer.
  5. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series.
- C. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
  1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06.
  2. ICI Dulux Paints; 4130-6130 Devshield Rust Penetrating Metal Primer.
  3. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer.
  4. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
  5. Sherwin-Williams; Kem Kromik Universal Metal.
- D. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
  1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04.
  2. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer.
  3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
  4. Sherwin-Williams; primer not required over this substrate.
  5. Sherwin-Williams; Galvite HS B50WZ30.

## 2.6 EXTERIOR FINISH COATS

- A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170.
  - 2. ICI Dulux Paints; 2406-XXXX Dulux Professional Exterior 100 Percent Acrylic Semi-Gloss Finish.
  - 3. Pittsburgh Paints; 6-900 Series SpeedHide Exterior House & Trim Semi-Gloss Acrylic Latex Paint.
  - 4. Sherwin-Williams; A-100 Latex Gloss A8 Series.
  
- B. Exterior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
  - 1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28.
  - 2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish.
  - 3. Pittsburgh Paints; 90 Line Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels.
  - 4. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.
  - 5. Sherwin-Williams; SuperPaint Exterior High Gloss Latex Enamel A85 Series.
  
- C. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
  - 1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28.
  - 2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish.
  - 3. Pittsburgh Paints; 90-300 Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels.
  - 4. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.

## 2.7 INTERIOR FINISH COATS

- A. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276.
  - 2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel.
  - 3. Pittsburgh Paints; 6-500 Series Speed Hide Interior Semi-Gloss Latex.
  - 4. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series.
  
- B. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.

1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel No. M28.
2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish.
3. Pittsburgh Paints; 6-8534 SpeedHide Interior Latex 100 Percent Acrylic Gloss Enamels.
4. Pittsburgh Paints; 90-374 Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamel.
5. Sherwin-Williams; ProMar 200 Interior Latex Gloss Enamel B21W201.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
  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 Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

### **3.2 PREPARATION**

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
  1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
  2. Cementitious Materials: Prepare concrete, concrete unit masonry, 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.
  3. 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.
- D. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
1. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  2. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- E. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- F. 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.
- G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### **3.3 APPLICATION**

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
  2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  3. Provide finish coats that are compatible with primers used.
  4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor 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.
  5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- 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.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

- F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

### **3.4 CLEANING**

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

### **3.5 PROTECTION**

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. 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 EXTERIOR PAINT SCHEDULE**

- A. Concrete: Provide the following finish systems over exterior concrete., stucco, and brick masonry substrates:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Exterior concrete.
    - b. Finish Coats: Exterior semigloss acrylic enamel.
  - 2. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Exterior concrete primer.
    - b. Finish Coats: Exterior full-gloss acrylic enamel for concrete.

- B. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:
  - A. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
    - a. Block Filler: Concrete unit masonry block filler.
    - b. Finish Coats: Exterior semigloss acrylic enamel.
  - B. Full-Gloss Acrylic-Enamel Finish: Two finish coat over a block filler.
    - a. Block Filler: Concrete unit masonry block filler.
    - b. Finish Coats: Exterior full-gloss acrylic enamel for masonry.
- C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
  - A. Semigloss Acrylic-Enamel Finish: Two finish over a rust-inhibitive primer.
    - a. Primer: Exterior ferrous-metal primer.
    - b. Finish Coats: Exterior semigloss acrylic enamel.
  - B. Full-Gloss Acrylic-Enamel Finish: Two finish over a rust-inhibitive primer.
    - a. Primer: Exterior ferrous-metal primer.
    - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
  - C. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
  - D. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
    - a. Primer: Exterior galvanized metal primer.
    - b. Finish Coats: Exterior semigloss acrylic enamel.
  - E. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
    - a. Primer: Exterior galvanized metal primer.
    - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

### **3.7 INTERIOR PAINT SCHEDULE**

- A. Concrete and Masonry: Provide the following paint systems over interior concrete and brick masonry substrates:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish over a primer.
    - a. Primer: Interior concrete and masonry primer.

- b. Finish Coats: Interior semigloss acrylic enamel.
- 2. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.
  - a. Primer: Interior concrete and masonry primer.
  - b. Finish Coats: Interior semigloss alkyd enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish over a primer.
    - a. Primer: Interior gypsum board primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
  - 2. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior gypsum board primer.
    - b. Finish Coats: Interior full-gloss acrylic enamel.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior ferrous-metal primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
  - 2. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior ferrous-metal primer.
    - b. Finish Coats: Interior full-gloss acrylic enamel.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior zinc-coated metal primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
  - 2. Full-Gloss Acrylic-Enamel Finish: Two finish over a primer.
    - a. Primer: Interior zinc-coated metal primer.
    - b. Finish Coats: Interior full-gloss acrylic enamel.

END OF SECTION 09912

## **SECTION 10155 TOILET COMPARTMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes phenolic-core units as follows:
  - 1. Urinal Screens and Toilet Compartments at Fleet Maintenance Building.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building.
  - 2. Division 6 Section "Rough Carpentry" for blocking.
  - 3. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of unit indicated.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

## **PART 2 - PRODUCTS**

### **2.1 PHENOLIC-CORE UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Accurate Partitions Corporation.
  - 2. American Sanitary Partition Corporation.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Global Steel Products Corp.
  - 5. Sanymetal; a Crane Plumbing Company.
  
- B. Panel Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch thick panels.
  - 1. Facing Sheet Color: One color in each room as selected by Architect from manufacturer's full range of colors.
  - 2. Core Color: Manufacturer's standard dark color.
  
- C. Mountings
  - 1. Urinal Screens: Wall mounted.
  - 2. Toilet Compartments : Floor Mounted.
  
- D. Brackets (Fittings):
  - 1. Stirrup Type: U-brackets, stainless steel.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Panels: 1/2 inch.
  
- B. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

END OF SECTION 10155

## **SECTION 10801 TOILET AND BATH ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Book Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following: Toilet Accessories At Fleet Maintenance Building.
- B. Related Work In Other Sections:
  - 1. Division 1 Section "Alternates" for work at Fleet Maintenance Building.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 2. Material and finish descriptions.
  - 3. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### **1.4 COORDINATION**

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

#### **1.5 WARRANTY**

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage

defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- D. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

### **2.2 TOILET ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  1. A & J Washroom Accessories, Inc.
  2. American Specialties, Inc.
  3. Bobrick Washroom Equipment, Inc.
  4. Bradley Corporation.
- C. Combination Toilet Tissue Dispenser:
  1. Basis-of-Design Product: Bobrick B-2888.
  2. Description: Combination unit with double-roll toilet tissue dispenser and the following:
  3. Mounting: Surface mounted.
- D. Combination Towel (Folded) Dispenser/Waste Receptacle:
  1. Basis-of-Design Product: Bobrick B-3942.
  2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
  3. Mounting: Semi-Recessed.
  4. Material and Finish: Stainless steel, No. 4 finish (satin).

- E. Sanitary Napkin Dispenser
  - 1. Basis-of-Design Product: Bobrick B-3500X2.
  - 2. Description: Combination Sanitary Napkin/Tampon Vendor. Double coin mechanism 50 cents.
  - 3. Mounting: Recessed.
  - 4. Material and Finish: Stainless steel, No. 4 finish (satin).
  
- F. Sanitary Napkin Receptor
  - 1. Basis-of-Design Product: Bobrick B-354.
  - 2. Description: Toilet partition mounted
  - 3. Mounting: Surface mounted.
  - 4. Material and Finish: Stainless steel, No. 4 finish (satin).
  
- G. Grab Bar:
  - 1. Basis-of-Design Product: Bobrick B-6806x36 or B-6806x42.
  - 2. Mounting: Flanges with exposed fasteners.
  - 3. Material: Stainless steel, 0.05 inch thick.
    - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
  - 4. Outside Diameter: 1-1/2 inches.
  - 5. Configuration and Length: As indicated on Drawings.
  
- H. Liquid-Soap Dispenser:
  - 1. Basis-of-Design Product: Bobrick B-2112.
  - 2. Description: Designed for dispensing soap in liquid or lotion form.
  - 3. Mounting: Deck mounted on vanity.
  - 4. Refill Indicator: Window type.
  
- I. Mirror Unit:
  - 1. Basis-of-Design Product: Framed Bobrick B-290 Series.
  - 2. Frame: Size: As indicated on Drawings.
  
- J. Shower Curtain Rod:
  - 1. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch thick stainless steel].
  - 2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
  - 3. Finish: No. 4 (satin).
  
- K. Robe/Towel Hook :
  - 1. Basis-of-Design Product: Bobrick B-672.
  - 2. Description: Double-prong unit.
  - 3. Material and Finish: Stainless steel, No. 4 finish (satin).

## 2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### **3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

## **SECTION 111126 VEHICLE WASHING EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Edition 1999 and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes a complete truck washing equipment system located in the Fleet Maintenance Building.
- B. Related Sections include the following:
  - 1. Division 1 Section 01230 "Alternates".
  - 2. Division 3 Section 03300 "Cast-In-Place Concrete"
  - 3. Masonry
  - 4. Mechanical
  - 5. Electrical

#### **1.3 SYSTEM DESCRIPTION**

- A. General: Provide a complete, integrated truck wash system including a completely automatic, touchless heavy-duty vehicle wash system which washes all types of street legal vehicles used by the City and County of Denver for front, roof, rear, both sides and chassis in drive-thru mode.
- B. The supplier is to be responsible for the supply of necessary equipment, materials and service for the complete assembly and erection of the equipment so that it is ready for operation.

#### **1.4 SUBMITTALS**

- A. Shop Drawings: For the complete truck wash system, include plans, elevations, sections, details, and attachments to other work.
  - 1. Provide layout for mechanical and electrical connections and coordinate installation.
  - 2. Submit an anchor-bolt plans before foundation and slab work begins. Include location, diameter, and projection of anchor bolts required to attach the truck wash equipment to the building.

- B. Samples for Initial Selection: For each type of truck wash equipment with factory-applied color finish.
- C. Manufacturer Certificate: Signed by manufacturer certifying that products comply with requirements.
- D. Operations and Maintenance Manual
  - 1. Assemble and provide two copies in 8.5 x 11 inch format. Fold out diagrams and illustrations are acceptable.
- E. Warranties: Warranty work specified herein is for one (1) year from substantial completion against defects in materials and in labor and workmanship. All rotating spinners have three (3) year full parts and factory labor warranty.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components and other manufactured items so as not to be damaged or deformed.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements:
  - 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
  - 2. Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed without field measurements. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for metal building systems is based on Red Arrow Manufacturing Arrowclean Performance Series Model #4A-50-B. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  - 1. InterClean Equipment, Inc.
- B. The wash system, high pressure cleaning systems, pumping stations and all controls shall be designed by one supplier.

- C. Supplier shall have been regularly engaged in the design and supply of the type of equipment specified herein, for a period of not less than five years. All similar items shall be the products of one manufacturer. The equipment offered shall be the latest standard product, modified as necessary to meet the requirements of the specification.

## **2.2 WASH SYSTEM PERFORMANCE**

- A. Operation: The vehicle washer shall be actuated in cycle sequence by vehicles driven in a fixed path between tire guides at a slow speed (50-60 feet/ minute) through the washing system. All washing operations and related water recycling operations shall be activated by a card key system.
- B. Chemical Wash Arch and Pump Station - Quantity Two
  1. Welded 1" stainless steel side and top manifolds supported on rugged 4" x 4" Aluminum arch frame.
  2. Side manifolds position toward front of vehicle as it enters arch, oscillate as vehicle passes through arch, and positions toward rear of vehicle as it leaves.
  3. 7.5 hp SS centrifugal pump, 50 gpm at 120 psi.
  4. Precision brass flat jet nozzles - uniform, non-atomizing, far reaching, high impingement energy.
  5. Quantity 2 (one on each side of vehicle) stand-alone spinning wheel blasters for intensified washing of wheels, rocker panels, fuel tanks, etc.
  6. Both arches share one 850 gal. water holding tank with overflow protection, level sensors and solenoid fill valve.
  7. Metered chemical injection pump.
  8. Bulk chemical holding tank.
  9. Activated by in ground traffic loop sensor.
  10. 16 ft wide by 15 ft vehicle clearance.
- C. High-Flow Rinse Arch and Pump Station - Quantity One
  1. Welded 1.5" stainless steel side and top manifolds supported on rugged 4" x 4" Aluminum arch frame.
  2. Side and top manifolds position toward front of vehicle as it enters arch, oscillate as vehicle passes through arch, and positions toward rear of vehicle as it leaves.
  3. 30 hp SS centrifugal pump, 175 gpm at 200 psi.

4. Precision power jet nozzles - flat uniform pattern, non-atomizing, far reaching, high impingement energy.
  5. Quantity 2 (one on each side of vehicle) stand-alone spinning wheel blasters for intensified rinsing of wheels, rocker panels, fuel tanks, etc.
  6. Under rinse manifold with an array of flatjet nozzles for underbody high pressure rinse.
  7. 850 gal. water holding tank with overflow protection, level sensors and solenoid fill valve.
  8. Activated by in ground traffic loop sensor.
  9. 16 ft wide by 15 ft vehicle clearance.
- D. Final Rinse Arch and Pump Station - Quantity One
1. Welded 1" stainless steel side and top manifolds supported on rugged 4" x 4" Aluminum arch frame.
  2. Side manifolds position toward front of vehicle as it enters arch, oscillate as vehicle passes through arch, and positions toward rear of vehicle as it leaves.
  3. 7.5 hp SS centrifugal pump, 50 gpm at 120 psi.
  4. Precision brass flatjet nozzles - uniform, non-atomizing, far reaching, high impingement energy
  5. Quantity 2 (one on each side of vehicle) stand-alone spinning wheel blasters for intensified washing of wheels, rocker panels, fuel tanks, etc.
  6. 850 gal. water holding tank with overflow protection, level sensors and solenoid fill valve.
  7. Activated by in ground traffic loop sensor.
  8. 16 ft wide by 15 ft vehicle clearance.
- E. Undercarriage Wash and Pump Station
1. Under rinse manifold with an array of flatjet nozzles for underbody washing.
  2. 15 hp SS centrifugal pump, 30 gpm at 200 psi
  3. Activated simultaneously with Arch #2

## 2.3 EQUIPMENT

- A. Tire Guide Rails

1. 3-Stage powder coated safety yellow.
  2. Extending entire length of washbay.
  3. Angled at entrance.
  4. Tube sections roll on supports.
- B. Master Control Panel
1. Industrial microprocessor based platform.
  2. Touchscreen control interface.
  3. Integrated with washbay overhead door controllers.
  4. Integrated with fuel card reader.
- C. Traffic Control System
1. Entrance and exit traffic lights controlled by master control panel
- D. Water Heater
1. 962,000 BTUH Natural gas fired instantaneous heater integrated with wash water holding tank.
- E. Water Softener
1. 300,000 grain, metered, 400# brine tank

## **2.4 Water Reclamation System**

- A. 150 gpm cyclonic particle separators.
1. Above ground cone bottom settling tank
  2. Odor control system
  3. Separate sump and processing pumps
  4. Operation integrated with master control panel
  5. Automatic fresh water override solenoid with low water float switch

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Contractor present, for compliance with requirements and metal building system manufacturer's tolerances.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary guys, braces, and other supports during erection to keep framing secure, plumb, and in alignment.

### **3.3 INSTALLATION**

- A. Install equipment in accordance with manufacturers' supplied installation drawings.
- B. Equipment supplier shall undertake the commissioning of the system and make all required adjustments to ensure proper operation.

### **3.4 SYSTEM START-UP**

- A. The equipment manufacturer shall start-up the system. The owner shall have all operating personnel present during the start-up and equipment training.
- B. The supplier shall arrange adequate amount of detergent for the performance testing.
- C. The owner's personnel shall be trained for a minimum of 5 hours in the system operation and maintenance.
- D. The supplier shall provide the owner the names and the addresses of all local service and maintenance personnel to assist in future service

END OF SECTION 111126

## **SECTION 13125 METAL BUILDING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions (City and County of Denver General Contract Orange Edition 1999) and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes metal building systems that consist of integrated sets of mutually dependent components including roof panels, wall panels, soffit panels, and accessories.
- B. Related Sections include the following:
  - 1. Division 1 Section "Alternates" for work at Trash Transfer Building.
  - 2. Division 3 Section "Cast-in-Place Concrete" for concrete foundations, slabs, and anchor-bolt installation.
  - 3. Division 3 Section "Precast Architectural Concrete" for wall panels.
  - 4. Division 8 Section "Steel Doors and Frames."
  - 5. Division 8 Section "Sectional Overhead Doors."

#### **1.3 SYSTEM DESCRIPTION**

- A. General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, metal soffit panels and accessories complying with requirements indicated.
  - 1. Provide metal building system of size and with spacings, slopes, and spans indicated.
- B. Primary Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- D. Secondary Frame Type: Manufacturer's standard purlins and joists and girts.

- E. Roof System: Manufacturer's standard vertical-rib, standing-seam metal roof panels, with insulation.
- F. Exterior Wall System: Manufacturer's standard field-assembled, insulated metal wall panels.

#### **1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Engineer metal building systems according to procedures in MBMA's "Metal Building Systems Manual."
  - 2. Design Loads: As indicated on Drawings.
  - 3. Load Combinations: Design metal building systems to withstand the most critical effects of load factors and load combinations as required by MBMA's "Metal Building Systems Manual."
  - 4. Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
  - 5. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E 1592.
- B. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
  - 1. Metal Roof Panel Assemblies:
    - a. R-Value: R19
  - 2. Metal Wall Panel Assemblies:
    - a. R-Value: R19
- D. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft.

- E. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at static-air-pressure difference of 6.24 lbf/sq. ft.
- F. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft.
- G. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.

## 1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal building system components:
  - 1. Structural-framing system.
  - 2. Insulated Metal roof panels.
  - 3. Insulated Metal wall panels.
  - 4. Flashing and trim.
  - 5. Accessories.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
  - 3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
  - 4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
    - a. Show roof-mounted items including equipment supports, pipe supports and penetrations, lighting fixtures,
    - b. Show wall-mounted items including doors, louvers, and lighting fixtures.
    - c. Show translucent panels.
  - 5. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
    - a. Flashing and trim.

- b. Gutters.
  - c. Downspouts.
- C. Samples for Initial Selection: For each type of building component with factory-applied color finish.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below.
- 1. Metal Roof and Wall Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
- E. Product Certificates: For each type of metal building system, signed by product manufacturer.
- 1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
    - a. Name and location of Project.
    - b. Order number.
    - c. Name of manufacturer.
    - d. Name of Contractor.
    - e. Building dimensions including width, length, height, and roof slope.
    - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
    - g. Governing building code and year of edition.
    - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure.
    - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
    - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
    - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- F. Welding certificates.
- G. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.
- H. Manufacturer Certificate: Signed by manufacturer certifying that products comply with requirements.
- I. Material Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
- 1. Structural steel including chemical and physical properties.
  - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.

- J. Source quality-control test reports.
- K. Field quality-control test reports.
- L. Maintenance Data: For metal panel finishes to include in maintenance manuals.
- M. Warranties: Special warranties specified in this Section.

## **1.6 QUALITY ASSURANCE**

- A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer.
  - 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain primary metal building system components, including structural framing and metal panel assemblies, through one source from a single manufacturer.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal building system and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- G. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

## **1.8 PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
  - 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
  - 2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

## **1.9 COORDINATION**

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## **1.10 WARRANTY**

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Siliconized Polyester Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 15 Hunter units when tested according to ASTM D 2244.

- b. Chalking in excess of a No. 2 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  3. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam, metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  1. Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: The design for metal building systems is based on Metallic Metal Building Company. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  1. Braemar Building Systems.
  2. Butler Manufacturing Company
  3. Ceco Building Systems; Division of Robertson-Ceco Corporation.
  4. Metallic Metal Building Company; Division of NCI Building Systems, LLP.

### **2.2 STRUCTURAL-FRAMING MATERIALS**

- A. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.

- C. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- E. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70.
- F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.
- G. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
  - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80; with Class AZ50 coating.
- H. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
  - 1. Finish: Plain.
- I. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- J. Primer: SSPC-Paint 15, Type I, red oxide.

### **2.3 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS**

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80, with G90 coating designation.
  - 2. Surface: Smooth, flat finish.
  - 3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings:

- a. Siliconized-Polyester Coating: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
- b. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions.
- c. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.

## **2.4 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS**

- A. Unfaced, Polyisocyanurate Board Insulation: ASTM C 591, Type II, compressive strength of 35 psi, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed.
- B. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.

## **2.5 MISCELLANEOUS MATERIALS**

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
  1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
  2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
  3. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
  4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  5. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- D. Metal Panel Sealants:
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
  - 2. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## **2.6 FABRICATION, GENERAL**

- A. General: Design components and field connections required for erection to permit easy assembly.
  - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- C. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

## **2.7 STRUCTURAL FRAMING**

- A. General:
  - 1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
    - a. Make shop connections by welding or by using high-strength bolts.
    - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.

- c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
    - d. Weld clips to frames for attaching secondary framing members.
    - e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
  2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
    - a. Make shop connections by welding or by using non-high-strength bolts.
    - b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.
- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
  1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by Architect.
  2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
- C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
  1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch.
  2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch-thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch wide flanges.
    - a. Depth: As required to comply with system performance requirements.
  2. Purlins: Steel joists of depths indicated.
  3. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch wide flanges.
    - a. Depth: As required to comply with system performance requirements.
  4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
  5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
  6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  7. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
  8. Purlin and Girt Clips: Minimum 0.0598-inch thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  9. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch thick.
  10. Framing for Openings: Channel shapes; fabricated from minimum 0.0598 thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
  11. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
  2. Cable: ASTM A 475, 1/4-inch diameter, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.

- F. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dipped galvanized bolts for structural-framing components that are galvanized.
- G. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
  - 1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
    - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
  - 2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.

## **2.8 METAL ROOF PANELS**

- A. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
  - 1. Material: Zinc-coated (galvanized) steel sheet, 0.0239INGH thick.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 2. Joint Type: Panels snapped together.
  - 3. Joint Type: Mechanically seamed.
  - 4. Panel Coverage: 24 inches.
  - 5. Panel Height: 2 inches.
  - 6. Uplift Rating: UL 90.
  - 7. Roof Expansion Joint: Portals Plus roof-to-roof expansion joint cover and reinforced Hypalon bellow with closed-cell foam backing.

## **2.9 INSULATION-CORE METAL WALL PANELS**

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and an insulation core foamed in place during fabrication, with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
  - 1. Panel Performance:
    - a. Flatwise Tensile Strength: 30 psi when tested according to ASTM C 297.

- b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for 7 days at 140 deg F and 100 percent relative humidity according to ASTM D 2126.
  - c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for 7 days at 200 deg F according to ASTM D 2126.
  - d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for 7 days at minus 20 deg F according to ASTM D 2126.
  - e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. positive and negative wind load and with deflection of L/180 for 2 million cycles.
  - f. Autoclave: No delamination when exposed to 2-psi pressure at a temperature of 212 deg F for 2-1/2 hours.
  - g. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
2. Isocyanurate Insulation-Core Performance:
- a. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
  - b. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
  - c. Shear Strength: 26 psi when tested according to ASTM C 273.
- B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
- 1. Facings: Fabricate panel with exterior and interior facings of same material and thickness.
    - a. Material: Zinc-coated (galvanized) steel sheet, 0.0179 inch thick.
    - b. Exterior Facing Finish: Fluoropolymer.
      - 1) Color: As selected by Architect from manufacturer's full range.
    - c. Interior Facing Finish: Manufacturer's standard siliconized polyester.
    - d. Exterior Surface: Smooth, flat.

## **2.10 METAL SOFFIT PANELS**

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal wall panels.
  - 1. Finish: Match finish and color of metal wall panels.

- C. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch wide flange for attaching interior finish; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
  - 1. Material: Zinc-coated (galvanized steel sheet, 0.0239 inch thick).
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.

## 2.11 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  - 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
  - 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  - 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1 inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, sills, corner units, clips, sealants, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from minimum 0.0159-inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
  2. Opening Trim: Minimum 0.0159-inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from minimum 0.0159-inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 inches o.c.
  2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Formed from 0.0159-inch thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet o.c.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

## **2.12 FINISHES, GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Erector, listing conditions detrimental to performance of work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

### **3.3 ERECTION OF STRUCTURAL FRAMING**

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base Plates: Clean concrete surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
  1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
    - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
  1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  2. Locate and space wall girts to suit openings such as doors and windows.
  3. Locate canopy framing as indicated.
  4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
  1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### **3.4 METAL PANEL INSTALLATION, GENERAL**

- A. Examination: Examine primary and secondary framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
  3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal panel manufacturer.

### **3.5 METAL ROOF PANEL INSTALLATION**

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations.
1. Install ridge and hip caps as metal roof panel work proceeds.
  2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels for fasteners.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.6 METAL WALL PANEL INSTALLATION**

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
  2. Shim or otherwise plumb substrates receiving metal wall panels.
  3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
  4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  5. Install screw fasteners in pre-drilled holes.
  6. Install flashing and trim as metal wall panel work proceeds.
  7. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
  8. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
  9. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Factory-Assembled, Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint with concealed clip and fasteners at maximum 42 inches o.c., but spaced not more than as recommended by manufacturer. Fully engage tongue and groove of adjacent insulated metal wall panels.
1. Install clips to supports with self-tapping fasteners.

2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.7 METAL SOFFIT PANEL INSTALLATION**

- A. Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### **3.8 ACCESSORY INSTALLATION**

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  3. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Tie downspouts to underground drainage system indicated.
- E. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
  - 1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
  - 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
  - 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
  - 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### **3.9 CLEANING AND PROTECTION**

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
  - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable accessories.

END OF SECTION 13125

CHERRY CREEK TRANSFER STATION  
FLEET MAINTENACE GARAGE  
DIVISION 15 SPECIFICATION INDEX

SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS  
SECTION 15100 – VALVES  
SECTION 15140 – HANGERS AND SUPPORTS  
SECTION 15190 – MECHANICAL IDENTIFICATION  
SECTION 15250 – MECHANICAL INSULATION  
SECTION 15400 – PLUMBING  
SECTION 15450 – PLUMBING FIXTURES  
SECTION 15488 – NATURAL GAS PIPING SYSTEMS  
SECTION 15860 – HVAC EQUIPMENT  
SECTION 15880 – AIR DISTRIBUTION  
SECTION 15920 – TEMPERATURE CONTROL SYSTEMS – ELECTRIC  
SECTION 15950 – SEQUENCE OF OPERATIONS  
SECTION 15990 – TESTING, ADJUSTING, AND BALANCING

## SECTION 15050 – BASIC MATERIALS AND METHODS

### PART 1 – GENERAL

#### 1.1 INCLUDED

Work of this Section generally includes provisions of labor, materials, equipment, accessories, necessary for installation of mechanical systems shown on the contract drawings and specified in the Project Manual. Intent of construction documents is to provide Owner with a complete and operating facility, and any minor items omitted but obviously necessary to accomplish intent, shall be provided whether or not shown or specified.

#### 1.2 RELATED

"General Requirements", Division 1 of the Project Manual pertains to and is hereby made a part of the work of this spec section. The requirements of this spec section apply to the work of all sections in DIVISION 1.

- A. Painting is Spec Section 9.
- B. Work performed by others includes installation of electrical equipment, except as noted otherwise on drawings or in specifications.
- C. Electrical Division 16.

#### 1.3 ORDINANCES AND CODES

- A. All work shall be executed and inspected in accordance with all Underwriters, public utilities, local and state codes and regulations applicable to the trade affected. Recommendations of AFA, NFPA, OSHA, and ASHRAE and applicable state energy code compliance shall be rigidly followed.
- B. Should any change in the plans and specifications be required to comply with these regulations, the Contractor shall notify the Architect before submitting his bid. After entering into the contract, the Contractor will be held to complete all work necessary to meet these requirements at his own expense.
- C. Where the work required by the drawings and specifications is above the standard required, it shall be done as shown or specified.
- D. Refer: Refer to Section 01060 regulating requirements in the Project Manual.

#### 1.4 PERMITS

Contractor shall arrange and pay for all permits and utility tap fees in connection with the work hereinafter specified and, at completion of the work, furnish the

Owner with the final certificate of inspection. All development, inspection and/or tap fees shall be paid for by the Contractor unless specifically noted to be paid by others.

#### 1.5 DRAWINGS

The drawings indicate the general arrangement of the proposed work. Details of the proposed departures due to actual field conditions or other causes shall be provided for. No extras will be paid for correcting faulty, poorly arranged, or poorly coordinated work.

#### 1.6 SITE EXAMINATION

This Contractor shall visit the premises so as to ascertain the existing conditions before submitting his bid, as no extras will be allowed for his lack of knowledge of these conditions.

#### 1.7 COMPLETE INSTALLATION & SERVICEABILITY

- A. The Contractor shall furnish and install all incidental parts, valves, fittings, pumps, control valves, and control wiring required for the proper function of all component parts. The complete installation shall function smoothly and noiselessly to the full extent of the plans and specifications. This Contractor shall complete his installation as rapidly as general construction permits. All filters, strainers, and safety devices shall be properly installed before starting equipment. The Owner shall be left with a new set of filters at final acceptance.
- B. All mechanical equipment shall be installed and piped to allow for easy accessibility for maintenance and operation of equipment. This shall include but not limit removal of motors, coils, filters, and any other component which would require service or replacement over the life of the equipment.
- C. Install piping, ductwork, mechanical equipment and similar services straight and true, aligned with other work, close to walls and overhead structure (allowing for insulation), concealed (except where indicated as exposed) in occupied spaces, and out-of-the-way with maximum passageway and headroom remaining in each space.
- D. Located operation and control equipment and devices for easy access. Install access panels where units are concealed by finishes and similar work.

#### 1.8 COORDINATION DRAWINGS

- A. Prepare coordination drawings and submit in accordance with Division 1 Section "Project Coordination" to a scale of 1/4-inch = 1'-0" or larger; detailing major equipment and materials in relationship with other systems, installations, and building components. 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 piping, ductwork, equipment, and materials. Include the following:
  - a. Clearances for installing and maintaining insulation.
  - b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
  - c. Equipment connections and support details.
  - d. Exterior wall and foundation penetrations.
  - e. Fire-rated wall and floor penetrations.
  - f. Sizes and location of required concrete pads and bases.
  - g. Valve stem movement.
2. Indicate scheduling, sequencing, movement and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

## 1.9 COORDINATION

- A. Before any equipment is purchased or fabricated and before running and/or fabricating any lines of piping or ductwork, the Mechanical Contractor and his Subcontractors shall assure themselves that they can be run as contemplated. Because of the small scale of the drawings, it is not possible to indicate all offsets, fitting, and accessories that may be required. The Mechanical Contractor and his Subcontractors shall carefully investigate all mechanical, electrical and structural drawings, along with the finish conditions affecting all of their work, furnishing any required fittings, valves, duct transitions, offsets and accessories as may be required to meet such conditions, at no additional cost.
- B. Integrate mechanical work in ceiling plenums with suspension system, light

fixtures and other work, so that required performances of each will be achieved.

- C. Give the right-of-way to piping systems required to slope for drainage over other service lines and ductwork.
- D. No piping shall be buried below slab except as specifically noted.

#### 1.10 TEMPORARY HEAT

Arrangements for usage of system for temporary heat shall be coordinated with General Contractor. System shall not be used for temporary heat unless all temporary filters are installed. Temporary filters and operation of units by General Contractor. Architect/Engineer to inspect equipment to verify their presence prior to start-up.

#### 1.11 SHOP DRAWING SUBMITTALS

- A. General: Follow the procedures in Division 1, Section – "Submittals".
- B. Within 15 days after notice to proceed, the Contractor shall submit to the Architect for approval six (6) copies of the shop drawings on each item of equipment as specified. Shop drawings shall give overall dimensions, weights, metal gauges, materials, certified capacities, brake HP, motor HP, tube diameters, friction drop fan curves, pump curves and nameplate data. The Contractor shall be responsible for checking shop drawings as to arrangement and performance, and shall indicate by stamp and signature same on shop drawings before submitting for approval. The AE's check shall be general and does not relieve the Contractor of final responsibility for a complete job to the intent of plans and specifications. All control diagrams and equipment shall be assembled in one submittal.
- C. Shop drawings are meant to communicate the contractor's interpretation of the requirements set out in the contract documents. They are descriptive technical submissions to show compliance with contractual requirements of specific items the contractor intends to include in the work, as well as how the items interface with other elements.
- D. Approval of a contractor's submission does not negate the contractor's obligation to strictly conform to the contract documents. If the shop drawings contain a deviation from the contract requirements, approval of the shop drawings by the AE acting as the client's agent shall not change the contract documents and constitute acceptance of the deviation.
- E. The contractor shall coordinate and check the shop drawings submitted by sub-contractor's or specialty contractors to ensure the proper interfacing and compatibility with the overall project. Sub-contractor's and specialty contractors shall prepare and furnish shop drawings to the prime contractor

that reflect intended compliances with the contract drawings and specifications.

#### 1.12 SUBSTITUTION OF EQUIPMENT

- A. General: Make substitutions as specified in Division 1, Section - "Substitutions".
- B. Bids shall be based on providing all equipment mentioned by brand name in plans and specifications. No substitutions shall be considered before execution of contract.
- C. All standard accessories as well as specified extras shall be provided with equipment.

#### 1.13 APPROVED MANUFACTURERS

Approval by name listed in this specification does not imply that the Manufacturer's standard product meets the intent of the drawings and specifications. It is the Contractor's responsibility to provide all necessary alterations, materials, labor, etc., as approved by the Architect/Engineer to meet the full intent of the drawings and specifications. This is to include, but not necessarily limited to electrical, structural, mechanical, and architectural alterations and revisions necessary to provide a complete and operating facility at no additional costs to the Owner.

#### 1.14 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate the following installed conditions:
  - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters; boxes; and terminal units requiring periodic maintenance or repair.
  - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 15 Section "Mechanical Identification". Indicate actual inverts and horizontal locations of underground piping.
  - 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

5. Contract Modifications, actual equipment and materials installed.
- B. Engage the services of a Land Surveyor or Professional Engineer registered in the State of Colorado as specified in Division 1 to record the locations and invert elevations of underground installations.

#### 1.15 WARRANTY

All material and workmanship installed and/or furnished under this section of work (Division 15) shall be guaranteed against defects for a period of one year from date of acceptance by Owner. Certificates shall be provided for all equipment and work covered by this warranty. Any defects or faulty workmanship shall be this Contractor's responsibility and shall be corrected entirely at his expense.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS

Materials throughout shall be new and of the best grades specified. They shall be standard catalog and manufactured by nationally known Manufacturers of the items specified. Contractor shall receive and be responsible for all owner-furnished equipment and provide rough-in and final connections for all mechanical equipment furnished under this contract or by others. This Contractor shall provide a suitable enclosure for the storage of all materials during progress of the job.

#### 2.2 FLOOR, CEILING PLATES, FLANGES

Provide tight fitting floor and ceiling plates on pipes passing through walls, ceilings, floors; nickel or chrome plated in finished areas. Provide wall and ceiling flanges for ducts in finished areas.

#### 2.3 PIPE HANGERS, SUPPORTS

Provide hangers, supports, braces and anchors to prevent undue strain, stresses, noise, vibration as described in Section 15140 of this specification.

#### 2.4 ELECTRIC MOTORS

- A. Motors 1/2 HP or Less: Split capacitor single-phase with sleeve bearings and shall be a standard frame size and RPM, available from more than one manufacturer.
- B. Motors 3/4 HP and Larger: Rated speed, voltage and phase shall be as scheduled or noted on the drawings. High efficiency type ODP enclosure, 40°C ambient, quiet, continuous duty, service factor of 1.15, copper windings, Class B or F insulation, standard mounting.

- C. Power Factor: All motors and equipment furnished under this section which are rated greater than 1-1/2 HP or 1000 watts, with an inductive reactance load component, shall have a power factor of not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected by Manufacturer or Supplier to be at least 90 percent under rated load conditions. Power factor corrective devices installed with the utilization equipment, except where this results in an unsafe condition or interferes with the intended operation of the equipment.
- D. The nameplate horsepower rating without consideration of the service factor, shall not be exceeded at any point along the performance curve of any pump at its rated rpm.
- E. Bearings: Double shielded ball in accordance with ANSI B3.16-1972.
- F. Motor Wiring: Terminate in a NEMA terminal box mounted on the motor case and of the manufacturer's standard size. The terminal box shall have a bolt type copper ground connector. Aluminum motor windings will not be allowed.
- G. Verify motor characteristics as shown on mechanical drawings with those shown on electrical drawings before ordering equipment. Have conflicts clarified.

## 2.5 MOTORS STARTERS

- A. Standard magnetic contactor-type for three-phase motors. Provide HAND-OFF-AUTO switch, overload heaters, 120 volt control transformer, single-phase protection, red running pilot light, under voltage protection and spare N.O. and N.C. contacts for control by Division 15. Equipment provided with integral starter shall have red running light and HAND-OFF-AUTO switch located at disconnect. Coordinate with Division 16. Single-phase motors shall be provided with manual starters. Provide NEMA enclosure appropriate for service, weatherproof type for outdoor and wet areas.
- B. Motors 20 HP and Larger: Provide reduced voltage type starters capable of adjustable acceleration rate control using voltage or current ramp. Motor starters shall be the solid state or closed transition wye-delta type. Part winding and open transition wye-delta motor starter will not be acceptable.
- C. Provide a phase monitor and control relay (phase failure relay) for each three-phase motor rated 5-HP or larger. The monitor relay shall be Square D Class 8430 DASV or equal. The phase failure relay shall be monitored to protect against under-voltage, phase failure and phase reversal. Provide a NEMA-1 enclosure for each relay for interior applications, NEMA-3R for exterior applications.

- D. Provide two-speed starters on mechanical equipment that use two-speed motors. Include an adjustable time delay device within the starter enclosure to allow the motor to come to a complete stop when switching from high to low speed. No time delay is required when switching from low to high speed.
- E. Starters shall be provided with overload elements, one for each phase.
- F. Set motors, deliver magnetic starters for installation under Division 16 or as called for in "Schedule of Responsibility" in "Electrical Wiring" – Part 3 of these Specifications.

MC = MECHANICAL CONTRACTOR  
 EC = ELECTRICAL CONTRACTOR  
 TC = TEMPERATURE CONTROL CONTRACTOR

Note 1: It is the intent of this specification for all conduit and wiring, which connects to control equipment or provides controls to mechanical equipment, to be provided by the Temperature Control Contractor. Other portions of this specification which may be in conflict with this concept shall be brought to the attention of the engineer for clarification prior to bidding the project. The electrical division shall provide line voltage wiring in conduit and junction boxes for the express purpose of

Schedule of Responsibility				
Item	Furnished by	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor magnetic starters & overload heaters	MC	EC	EC	MC
Other equipment motors/starters	MC	MC	EC	--
Fused & un-fused disconnect switches, thermal overload and heaters	EC	EC	EC	--
Pushbutton stations and pilot lights	MC	MC	EC	TC (Note 2)
Manual operating & speed switches	MC	EC	EC	EC
Control wiring	TC	TC	TC (Note 1)	TC
Control components: control relays, thermostats, control transformers, switches, transmitters	TC	TC	TC (Note 1)	TC
Temperature control panels, time clocks, controllers, time switches	TC	TC	TC (Note 1)	TC
Valve and damper motors and actuators	TC	MC	EC/TC	TC
Control valves, solenoid valves	TC	MC	EC/TC	TC
Control Dampers integral with a fan unit	MC	MC	TC	TC
All PE & EP switches	MC	MC	--	MC
Control dampers (duct mounted)	TC	MC	-	-
Thermowells in piping	EC	EC	EC	TC
Temporary heating or cooling connection	MC	MC	EC	TC
Duct detectors	EC	EC	EC	TC
Basic Materials And Methods Refrigeration cycle controls	MC	MC	EC	MC <sup>15050 - 9</sup>
Boiler Controls	MC	MC	EC	MC

temperature controls. It shall be the responsibility of the Temperature Control Contractor to coordinate the location of the junction boxes (if not otherwise shown on the electrical drawings) and to utilize these junction boxes for temperature control wiring. The Temperature Control Contractor shall extend line and/or low voltage wiring from junction boxes to all mechanical and control components, which require control wiring.

Note 2: Connection of auxiliary contacts, if required.

Note 3: Device is used in power wiring circuit to the equipment. Control functions are not required.

- G. All temperature control conduit and wiring will be furnished and installed under the Temperature Control contract.
- H. Division 16 Contractor shall furnish and install all wiring and conduit required for power wiring to carrying equipment full load amperage to all mechanical equipment unless shown otherwise.
- I. All Contractors shall confirm their scope of supply prior to ordering equipment. The Owner shall not be responsible for delays due to missing equipment charges for expediting equipment or charges for re-stocking equipment overages.

## **PART 3 – EXECUTION**

### **3.1 ROUGH-IN**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Division 15 for rough-in requirements.

### **3.2 MECHANICAL INSTALLATIONS**

- A. General: sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
  - 2. Verify all dimensions by field measurements.
  - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
  - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual systems requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Coordinate locations of all access panels or doors required for mechanical systems. Access panels and doors are specified in Section 083113.
12. Coordinate with Architectural Drawings for all ceiling types and interface with proper diffusers, registers, grilles, access doors, sprinkler heads, etc., as required.
13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
14. Supports, bracing, platforms, access stairs, catwalks or ladder required for service are specifically included in this scope of work. Provide fully engineered drawings for review. Supports, etc. shall be designed to transmit vertical loads only to structural frame; elements transmitting rotational loads will be rejected. Supports shall be

galvanized steel. The drawings shall be submitted with the complete approval of a locally registered Professional Engineer. It shall be the Contractor's complete and full responsibility to acquire any and all required permits to perform this work from the appropriate governing code authorities.

### 3.3 WORKMANSHIP

- A. Work throughout shall be performed by persons skilled in the installation of the various parts of the work herein specified.
- B. All piping and ductwork shall run concealed in finished areas except where noted otherwise or as chrome plated plumbing fixture connections.

### 3.4 REMOVAL OF EXISTING WORK

All existing mechanical equipment, piping, etc., removed by this Contractor shall become his property and he must remove same from premises. Allowance shall be made in bid for salvageable items.

### 3.5 CURBS, BASES, SUPPORTS

Major curbs, opening, and equipment supports will be provided under the General Section of this contract only where shown on architectural or structural plans. All other supports, anchors, and bases shall be provided by Mechanical Contractor for all mechanical equipment. Equipment shall be supported per Manufacturer's written recommendations for noise-free installation.

### 3.6 SLEEVES AND CHASES

- A. Provide chases, holes, sleeve, boxes, inserts, hangers, for mechanical equipment, piping, ducts, etc.
- B. For ducts through walls, ceilings, floors, provide sheet steel sleeves of suitable size fastened to construction with sleeve ends flush with finished surfaces. For pipes passing through masonry or concrete construction, provide sleeves in accordance with these specifications.
- C. Work Included: Provide sleeving through all concrete and masonry, for pipes and ducts. Provide wall seals in any sleeve conveying pipe through wall to exterior which is below grade or where otherwise specified.
- D. Except where specified, sleeves shall be steel pipe. Use galvanized sheet steel, galvanized steel pipe, or pre-manufactured sleeves.
- E. The diameter shall be such that the annular clear space is approximately 1/4" larger for wall seal sleeves. Insulation shall pass through the sleeve, except caulk sleeves and exposed heated piping through finished floors.

- F. For sleeves through foundation walls below grade, use galvanized steel pipe, Schedule 40; or cast iron pipe. The pipe passing through the sleeve shall be centered. Use wall seal of proper size.
- G. For all piping through floors where open chase is not provided and at all concealed penetrations of floors, use hot dip galvanized steel pipe, extending 6" above finished floor. For all piping through floors in exposed areas, use galvanized steel pipe, flush with floor.
- H. Provide cushion inserts in the sleeves for all uninsulated plumbing piping, tightly fitted to the pipe. Within sleeves through wall openings, provide Potter-Roemer PR Isolators, Elcen, or equal, with galvanized steel shell, 1/2" hair felt cushion. Attach the cushion inserts in the sleeves using an epoxy cement.
- I. On all sleeves through roof membrane, provide a clamping device, 4-pound sheet lead pan all around each clamp, to support the membrane. Provide a galvanized steel pipe nipple through the roof, around the pipe extending to 6" above finishes roof, and provide polystyrene rope packing and polysulfide sealant between the pipe and the nipple.
- J. For piping through masonry walls, use hot dip galvanized sheet steel pipe. Center over wall and extend 2" on either side of wall.
- K. For piping through gypsum board wall, use galvanized sheet steel pack with oakum. Center over wall and extend 2" on either side of finished surface.
- L. Fire Stopping and Grouting: Around pipes and ducts, concrete slabs and walls, and masonry walls, use Portland cement grout in the sleeved opening, and extending full depth through wall or floor slab, with sheet metal over the insulation before grouting in. Around pipes and ducts through drywall construction, pack void with rope caulking and finish with sheet metal collar on ducts and escutcheons on pipe. Use at all fire-rated walls and floors.

### 3.7 PIPING INSTALLATION

- A. Provide proper grades, slopes, elevations with readily accessible drainage connections at low points so entire system may be completely drained. Install unions at all coils for easy removal of coils without extensive piping or valve removal.
- B. Allow for expansion-contraction to avoid distortion, damage, or improper operation. Make certain piping above and below grade is not inadvertently anchored; if questionable obtain clarification.
- C. Arrange and install piping approximately as indicated -- straight, plumb, and as direct as possible; from right angles or parallel lines with building walls. Keep pipes as close to walls, partitions, ceilings, as possible. All piping to be

concealed in building construction, unless noted or shown otherwise. Keep fixtures branches concealed except for final connections.

- D. Install dielectric insulating unions wherever piping connects to dissimilar metals.
- E. Interface With Other Trades: Before installing piping, check mechanical drawings with other drawings and arrive at mutual agreement with other trades where interfaces may occur. Obtain approval of proposed changes.
- F. Protect Open Piping: Keep piping from scale and dirt, protect open pipe ends whenever work is suspended during construction.

### 3.8 FREEZE PROTECTION

Lines shall not be run in outside walls, ventilated ceiling spaces, attic spaces or locations where freezing may occur. Piping next to outside walls or ceilings shall be furred spaces with insulation between the piping and the outside wall. In the ceiling spaces, piping shall be installed on the warm side of the insulation batts. Insulation of the piping shall not be considered freeze protection.

### 3.9 CUTTING AND PATCHING

The Mechanical Contractor shall cut and patch as required for his installation. Before any cutting is done, Architect's written permission shall be obtained and the Contractor shall perform this work at no extra cost to the contract, if cutting is due to his neglect or failure to keep pace with construction. Drill holes only in locations approved by Architect.

### 3.10 EXCAVATION AND BACKFILLING

- A. Do all required excavation for laying of water lines, soil and waste lines, drainage and other piping underground and for all work under this specification. Refer to Section 15400 for additional requirements.
- B. The bottom of all trenches shall be scooped out so that piping or conduit will rest on bottom of trenches. After piping in trenches has been inspected and approved by Architect, the trenches shall be backfilled in layers with the earth well tamped. Backfilling shall be carefully done so as not to disturb piping. Any settlement shall be refilled, tamped and refinished at this Contractor's expense.

### 3.11 REMOVAL OF RUBBISH

On completion of his work, the Contractor shall remove all of his tools, scaffolding, debris, etc., from the grounds and leave the premises perfectly clean.

### 3.12 SOLDER

All solder used on sweat fittings shall be 95–5 hard solder unless brazing or silver solder is specified. Solder containing lead shall not be used anywhere on this project.

### 3.13 WELDING

All welding shall be done by welders currently approved by the National Certified Pipe Welding Bureau. Chill rings shall be used to keep welding beads out of piping.

### 3.14 ACCESS PANELS

Provide key operated and hinged access panels of size required to properly maintain and operate valves and equipment. Provide fire rated access doors where required. Provide U.L. label on each fire rated access door.

### 3.15 ELECTRICAL WIRING

- A. All line voltage wiring including switches, disconnects, conduits and starters will be as scheduled herein.
  - 1. Schedule of Responsibility: Unless otherwise indicated, all mechanical equipment motors and controls shall be furnished, set in place, and wired in accordance with the following "Schedule of Responsibility".

### 3.16 OPERATING AND MAINTENANCE INSTRUCTIONS

Upon completion, the Contractor shall make up sets of operating and maintenance manual in accordance with Division 1, Section Maintenance Manuals and as specified herein. Provide instructions covering all mechanical equipment with moving or moveable parts including general operating of heating, plumbing and cooling systems and shall give the Architect four (4) copies of these instructions – one copy retained by the Engineer, one copy to be retained in the Architect's files and the other two to be transmitted to the Owner. Instructions shall be typewritten to the Owner. Instructions shall be typewritten for particular job, and bound. Manufacturer's printed operation and maintenance instructions shall also be provided for each piece of equipment. Include the above valve tag numbers in these instructions.

- A. Name, address, and telephone number of party to be contracted for 24–hour service for each item of equipment.
- B. Starting, stopping, lubrication, and adjustment shall be clearly indicated for each piece of equipment.
- C. The Owner shall be thoroughly instructed by a Factory Representative on each piece of equipment.

- D. Prepare 8-1/2" x 11" blueprints with binding edge of appropriate scale to indicate all equipment, respective switches, and valve locations. Bind in instruction book.

SECTIONS	SHOP DRAWINGS	QUALIFICATIONS CERTIFICATIONS	GUARANTEE WARRANTY	O & M MANUALS	TESTING REPORTS	RECORD DRAWINGS
15050	X	X	X	X	X	X
15100	X			X		X
15140	X					
15190	X			X		
15250	X		X	X		
15400	X		X	X	X	X
15450	X		X	X	X	
15488	X	X	X	X	X	X
15750	X		X	X	X	X
15860	X		X	X		X
15880	X		X	X		X
15910	X	X	X	X	X	X
15950	X	X	X	X		
15990	X	X	X		X	X

### 3.17 TESTING

- A. All piping systems shall be tested at 150 percent of its maximum design working pressure. Leaks shall be corrected by remaking joints. Controls, relief valves, and equipment not able to withstand test pressure shall be removed from system during test. Consult governing codes for sanitary refrigeration, and special systems.
- B. Refer to testing methods and procedures under each subsequent section of these specifications. All tests to be witnessed by Architect.

### 3.18 OBJECTIONABLE NOISE AND VIBRATION

Mechanical equipment shall operate without objectionable noise or vibration, as determined by Architect. If objectionable noise or vibration is produced and transmitted to occupied portions of building by apparatus, piping, ducts, or other parts of mechanical equipment, make necessary changes and additions as approved, without extra cost.

### 3.19 ALTITUDE CORRECTION

- A. All air moving equipment to be rated, selected, and adjusted to deliver air quantities shown at 5200 ft. elevation. Fan speeds to be changed as required to deliver CFM shown and new sheaves furnished and installed if necessary.

- B. Fuel burning equipment, except atmosphere type gas burners, shall deliver full rated capacity at 5200 ft. elevation.

**END OF SECTION 15050**

## SECTION 15100 – VALVES

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. The work covered under this Section consists of furnishing all materials, equipment and labor necessary to make the installation of the valves complete as indicated on the plans and as herein specified.
- B. Types of valves specified in this Section include the following:
  - 1. Ball Valves
  - 2. Balance Valves
  - 3. Calibrated Balance Valves
  - 4. Butterfly Valves
  - 5. Check Valves
  - 6. Plug Valves
  - 7. Drain Valves
  - 8. Valve Operators

#### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
- C. Delivery, storage and handling of materials and equipment shall be in such a manner which will protect and prevent materials and equipment from damage. Any damaged materials or equipment shall be replaced at the Contractor's expense. Refer to Section 01620 "STORAGE AND PROTECTION" for additional requirements.

### PART 2 – PRODUCTS

## 2.1 APPROVED MANUFACTURERS:

- A. All valves shall consist of one manufacturer. The following manufacturers will be considered as equal to the Base Manufacturer as specified.
- B. Apollo, Armstrong, B&G, Crane, Darling, DeZurick, Gerand, Hammond, Illinois, Iowa, Jenkins, Keystone, Lunkenheimer, M&H, Milwaukee, Mueller, Nibco, Pacific States, Powell, Stockman, Taco, Walworth, or approved equal.

## 2.2 BALL VALVES

- A. Ball Valves – 1" and Smaller: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 2-piece construction, with bronze body conforming to ASTM B 62, full port, chrome-plated brass ball (vented, stainless steel ball for steam and condensate), replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.
- B. Ball Valves – 1-1/4" to 2": Rated for 400 psi WOG pressure; 3-piece construction, bronze body conforming to ASTM B 62, full port, chrome-plated brass ball (vented, stainless steel ball for steam and condensate), replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.

## 2.3 BALANCE VALVES

- A. Plug Valves – 2" and Smaller: Rated at 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.
- B. Plug Valves – 2-1/2" and Larger: 175 psi, WOG lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

## 2.4 CALIBRATED BALANCE VALVES

125 psig water working pressure, 250 degrees F maximum operating temperature, bronze body, plug valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2" and smaller shall have threaded connections and 2-1/2" valves shall have flanged connections. Provide differential pressure meter and readout kit. Make: Bell and Gossett, Taco, Gerand, or Illinois.

## 2.5 GLOBE VALVES

- A. Globe Valves – 2" and Smaller: Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated

packing, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires.

- B. Globe Valves – 2-1/2" and Larger: Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends and "Teflon" impregnated packing and two-piece backing gland assembly.

## 2.6 BUTTERFLY VALVES

Butterfly Valves – 2-1/2" and Larger: 200 psi, cast iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, with nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches. Provide lug or wafer type as indicated. Drill and tap valves on dead-end service or requiring additional body strength.

## 2.7 CHECK VALVES

- A. Swing Check Valves – 2" and Smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications with threaded end connections, where system pressure requires or where Class 125 valves are not available.
- B. Swing Check Valves – 2-1/2" and Larger: Class 125 cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Provide valves capable of being refitted while the valve remains in the line.
- C. Vertical Lift Check Valves: Iron body, bronze trimmed, 200 lb. WPS, iron body vertical lift check valve. Make: Jenkins 153-B, sizes 3" thru 6" or equal.

## 2.8 PLUG VALVES

Eccentric Plug Valves: Non-lubricated plug design, semi-steel body, bronze faced plug, 175 lb. WOG. 1/2" to 2-1/2" Model 425 threaded. 3"-4" flanged. Each #425 valve shall be installed with #478 adjustable balancing top. Make: DeZurik.

## 2.9 DRAIN VALVES

3/4" all bronze, wheel handle, brass seat and 3/4" hose end outlet, 1/2" FPT inlet.

## 2.10 VALVE OPERATORS

Provide the following special operator features:

- A. Handwheels fastened to valve stem, for valves other than quarter turn.
- B. Lever handles on quarter turn valves 6" and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
- C. Chain-wheel operators for valves 2-1/2" and larger installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation and mount to wall.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matters, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valves closure member to the shipping position.
- C. Examine threads on both the valve and the mating pipe for form (i.e. out-of-round or local indentation) and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

### **3.2 VALVE ENDS SELECTION**

Select valves with the following ends or types of pipe/tube connections:

- A. Copper Tube Size, 2-inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
- B. Steel Pipe Sizes 2-inch and Smaller: Threaded end.

- C. Steel Pipe Sizes 2½-inch and Larger: Flanged.

### 3.3 VALVE INSTALLATIONS

- A. General Application: Use ball and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements. All valves shall be full line size unless specifically noted otherwise.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install bypass lines with globe valve around each pressure reducing valve.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
  - 1. Swing Check Valves: Horizontal position with hinge pin level.
  - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
  - 3. Lift Check Valve: With stem upright and plumb.

### 3.4 SOLDER CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to full open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

- G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

### 3.5 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

### 3.6 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

### 3.7 FIELD QUALITY CONTROL

Tests: After piping systems have been tested and put into service, but before final adjusting and balancing inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

### 3.8 ADJUSTING AND CLEANING

Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

**END OF SECTION 15100**

## SECTION 15140 – HANGERS AND SUPPORTS

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.
- B. Provide all required pipe hangers, supports, and anchors; and all required ductwork hangers and supports as specified herein.

#### 1.3 QUALITY ASSURANCE

- A. Codes and Standards:

Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.

- B. UL and FM Compliance:

Provide products which are UL and FM approved.

### PART 2 – PRODUCTS

#### 2.1 APPROVED MANUFACTURERS

Elcen, Fee & Mason, Unistrut, Grinnell or approved equal.

#### 2.2 PIPE HANGERS AND SUPPORTS

- A. Hangers (Malleable Iron or Carbon Steel Piping):

- 1. Pipe Sizes ½" to 1-1/2": Use malleable iron with adjustable swivel, split ring.
- 2. Pipes Sizes 2" to 4" and Cold Pipe Sizes 6" and Over: Use adjustable wrought steel clevis.

- B. Wall Support:
  - 1. Pipe Sizes up to 3": Use cast iron hook.
  - 2. Pipe Sizes 4" and Over: Use welded steel bracket and wrought steel clamp, adjustable steel yoke.
- C. Vertical Support: MSS Type 42; use carbon or alloy steel riser clamp for steel or malleable iron pipe; use copper riser clamp for copper pipe.
- D. Floor Support:
  - 1. Pipe Sizes Up to 4" and All Cold Pipe Sizes: Use cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier or steel support.
- E. Shields:
  - 1. Insulated Piping 2" and Smaller: MSS Type 40; provide No. 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12" long at pipe support.
  - 2. Insulated Copper Piping 2-1/2" and Larger: Provide thermal hanger shields constructed of 360 deg insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 deg 18 gauge galvanized sheet metal shield. Provide assembly of same thickness as adjoining insulation. This shield is not a MSS Type.
  - 3. Steel Piping 2-1/2" and Larger: MSS Type 39; provide pipe covering steel protection saddle welded to pipe. Fill interior voids with segments of insulation matching adjoining insulation.
- F. Design Hangers to impede disengagement by movement of supported pipe.
- G. Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.

### 2.3 PIPE ANCHORS

- A. Provide steel pipe clamps, 1-5/8" minimum stock width, bolted on both sides of the clamp.
- B. Bolts:
  - 1. Pipe Sizes Up to 3": 3/8".
  - 2. Pipe Size 4: 1/2".

## 2.4 HANGER RODS

Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded. Sizes as indicated in Paragraph 3.2 of this Section.

## 2.5 DUCT HANGERS AND SUPPORTS

- A. Hangers: Galvanized steel band iron or rolled angle and 3/8-inch rods.
- B. Wall Supports: Galvanized steel band iron or fabricated angle bracket.

# PART 3 – EXECUTION

## 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

## 3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts..
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick. hangers shall be installed with hanger attachment in

shear, not in withdrawal.

- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Support fire protection systems piping independent of other piping.
- I. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bents, and similar units.
- J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- L. Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance (Max) Between Supports	Hanger Rod Diameter
1/2"	6'-0"	3/8"
3/4" to 2"	6'-0"	3/8"
2-1/2" and 3"	10'-0"	1/2"
4: and 5"	10'-0"	5/8"

- M. Install hangers to provide minimum 1/2" clear space between finished covering and adjacent work.
- N. Place a hanger within 1'-0" of each horizontal elbow.
- O. Use hangers which are vertically adjustable to 1-1/2" minimum after piping is erected.
- P. Support horizontal soil pipe within 18" of each hub, with 5'-0" minimum after piping is erected.

- Q. Support horizontal no-hub piping within 12" on both sides of every clamp.
- R. Support vertical piping at every floor or maximum of 10'-0 intervals. Support vertical soil pipe at each floor at hub.
- S. Where practical, support riser piping independently of connected horizontal piping.
- T. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
  - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  - 3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. shields span an arc of 180 degrees and have dimensions in inches not less than the following:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>
1 / 4 to 3	12
4	12
5 and 6	18

- 4. Insert Material: Length at least as long as the protective shield.
- 5. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitation.

- C. Field Welding: comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, 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.
  4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

### 3.5 PIPE ANCHORS

Rigidly support pipe anchors from building steel structure. Provide all necessary steel bracing for pipe anchors to accomplish the Work. All required steel bracing shall be welded to building structure and onto itself to provide an adequate rigid pipe anchor support.

### 3.6 DUCT HANGERS AND SUPPORTS

Low and medium pressure ductwork hangers and supports shall be in accordance with the latest edition of the SMACNA Manual and the requirements of the local building codes.

### 3.7 PRIMING

Manufactured hangers are normally supplied in black steel. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

### 3.8 SUPPORTS FOR PIPING AT PUMPS

Support the elbow of the piping (or suction diffusers) with steel supports from the inertia base to prevent loading heavy weights of piping on pump casings.

### 3.9 ADJUSTING

Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.10 PAINTING

- A. Touching Up: Cleaning and touch up painting of field welds, bolted

connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting".

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing–repair paint to comply with ASTM A 780.

**END OF SECTION 15140**

## SECTION 15190 – MECHANICAL IDENTIFICATION

### PART 1 – GENERAL

#### 1.1 RELATED

- A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification sections, apply to work of this section.
- B. This section is part of each Division 15 Basic Division 15 section making reference to identification devices specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division 15 sections.
- B. Types of identification devices specified in this section include the following:
  - 1. Painted identification materials
  - 2. Plastic pipe markers
  - 3. Plastic tape
  - 4. Underground-type plastic line marker
  - 5. Plastic duct markers
  - 6. Valve tags
  - 7. Valve schedule frames
  - 8. Engraved plastic-laminate signs
  - 9. Plastic equipment markers
  - 10. Plasticized tags
- C. Mechanical identification of factory-fabricated equipment shall be furnished by factory fabricated equipment manufacturer.
- D. Refer to Division 16 sections for identification requirements of electrical work; not work of this section.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

Firm regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:

1. 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. A listing of applicable reference standards is contained in Section 01012 and Section 01091.
  2. ANSI Standards: Comply with ANSI A13.1 for lettering size length of color field, colors and viewing angles of identification devices.
- C. Delivery, storage and handling of materials and equipment shall be in such a manner which will protect and prevent materials and equipment from damage. Any damaged materials or equipment shall be replaced at the contractor's expense. Refer to Section "Storage and Protection" for additional requirements.
- D. A sample installation of each type of marking shall be installed for determining the pattern to be used in installing each type of marking. These installations shall be reviewed to determine the pattern for the rest of the work.

#### 1.4 SUBMITTALS

- A. General: Submit copies of shop drawings, product data and performance data for manufactured products and assemblies as specified herein and under provisions of Division 1, Section "Submittals."
- B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- C. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- D. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8½" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variation for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals as specified in Division 1.
- E. Maintenance Data: Include product data and schedules in maintenance manuals in accordance with requirements of Division 1.
- F. Contractor shall submit a plan and drawing identifying the location of all identifiers, type of identifiers at each location and the wording or marking on each identifier.

## PART 2 – PRODUCTS

## 2.1 APPROVED MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
1. Allen Systems, Inc.
  2. Brady (W.H.) Co.; Signmark Division
  3. Industrial Safety Supply Co., Incorporation
  4. Seton Name Plate Corporation

## 2.2 MECHANICAL IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections, which fully comply with the contract document requirements. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category.

## 2.3 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semigridd snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Insulation: Furnish one inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend two inches beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than six inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
  2. Adhesive lap joint in pipe marker overlap.
  3. Laminated or bonded application of pipe marker to pipe (or insulation).
  4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1½-inch.
- E. Large Pipes: For external diameters of six inches and larger (including insulation, if any), provide either full-band or strip-type markers, but not narrower than three times letter height (and of required length), fastened by

one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
  2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1½-inch wide; full circle at both ends of pipe marker, tape lapped three inches.
  3. Strapped-to-pipe (or insulation) of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect in cases of variance with name as shown or specified.
- G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
- H. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

#### 2.4 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:
1. Green: Cold air
  2. Yellow: Hot air
  3. Yellow/Green: Supply air
  4. Blue: Exhaust, outside, return and mixed air
  5. For hazardous exhaust, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following:
1. Direction of air flow
  2. Duct service (supply, return, exhaust, etc.)
  3. Duct origin (from)
  4. Duct destination (to)
  5. Design cfm

#### 2.5 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1½-inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6-inch, 2½-inch wide tape for larger

pipes.

- C. Color: Comply with ANSI A13.1 except where another color selection is indicated.

## 2.6 UNDERGROUND-TYPE PLASTIC LINE MARKERS

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic tape.

## 2.7 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation 1¼-inch high letters and sequenced valve number 1/2-inch high, and with 5/32-inch hole for fastener.
  - 1. Provide 1½-inch diameter tags, except as otherwise indicated.
  - 2. Provide size and shape as specified or scheduled for each piping system.
  - 3. Fill tag engraving with black enamel.
- B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
- C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

## 2.8 VALVE SCHEDULE FRAMES

General: For each page of valve schedule, provide glazed display with screws for removable mounting on masonry walls. Provide frames of finished extruded aluminum or steel, with SSB-grade sheet glass for each page.

## 2.9 ENGRAVED PLASTIC LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and working indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of

substrate.

- B. Thickness: 1/8-inch, except as otherwise indicated.
- C. Thickness: 1/16-inch for units up to 20 square inches or 8-inch length; 1/8-inch for larger units.
- D. Fasteners: Self-taping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

## 2.10 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:
  - 1. Green: Cooling equipment and components.
  - 2. Yellow: Heating equipment and components.
  - 3. Yellow/Green: Combination cooling and heating equipment and components.
  - 4. Brown: Energy reclamation equipment and components.
  - 5. Blue: Equipment and components that do not meet any of the above criteria.
  - 6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
  - 1. Name and plan number
  - 2. Equipment service
  - 3. Design capacity
  - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide approximate 2½-inch x 4-inch markers for control devices, dampers, and valves; and 4½-inch x 6-inch for equipment.

## 2.11 PLASTICIZED TAGS

General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for wiring, approximately 3¼-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed working including large-size primary wording (as examples: DANGER, CAUTION, DO NOT OPERATE).

## 2.12 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in

mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and working as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Boiler No. 3, Air Supply No. 1H, Standpipe F12, Exhaust Fan No, 10).

## **PART 3 – EXECUTION**

### **3.1 GENERAL INSTALLATION REQUIREMENTS**

Coordination: Where identification is to be applied to surfaces which requires insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

### **3.2 DUCTWORK IDENTIFICATION:**

- A. General: Identify air supply, return, exhaust, intake, and relief ductwork with duct markers; or provide signage and arrows, showing ductwork service and direction of flow, in black or white (whenever
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates (each side of wall/partition or floors), or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 feet spacings along exposed runs.

### **3.3 PIPING SYSTEM IDENTIFICATION**

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow or venting:
  - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enters non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

#### 3.4 UNDERGROUND PIPING IDENTIFICATION

General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground type plastic line marker, located directly over buried line at 6 inches to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For tile field and similar installations, mark only edge pipe lines of field.

#### 3.5 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect.

Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than

single machine room.

### 3.6 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  2. Meters, gauges, thermometers and similar units.
  3. Fuel burning units including water heaters.
  4. Pumps, compressors and similar motor-driven units.
  5. Coils, evaporators, heat recovery units and similar equipment.
  6. Fans, blowers, primary balancing dampers and mixing boxes.
  7. Packaged HVAC central-station and zone-type units, terminal unit VAVs, fan-powered VAVs.
  8. Strainers, filters, water treatment systems, and similar equipment.
- B. Optional Sign Types: Where lettering larger than one inch height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at installer's option after receiving approval by the Architect.
- C. Lettering Size: Minimum 1/4-inch high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- E. Optional Use of Plasticized Tags: At installer's option and after receiving approval by the Architect, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment). Install a white thumbtack 1/2" head with point

retainer on corner of acoustical ceiling tile below on control side of terminal units and valve locations.

Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

### 3.7 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

### 3.8 EXTRA STOCK

- A. Furnish minimum of 5 percent extra stock of each mechanical identification material required, including additional blank valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
- B. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

**END OF SECTION 15190**

## SECTION 15250 – MECHANICAL INSULATION

### PART 1 – GENERAL

#### 1.1 RELATED

“General Requirements”, Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

The intent of these specifications and the accompanying plans is to describe the complete systems to be insulated, including materials and necessary labor.

A. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation.
2. Ductwork System Insulation.

B. Refer to Section 15880 and drawings for duct liner.

#### 1.3 SUBMITTALS

In addition to the requirements outlined in Section 15050, provide formal submittals of all insulation to be used, including thermal properties, sound absorption characteristics, flame and smoke ratings, and air friction coefficients where applicable. Provide samples when requested.

#### 1.4 QUALITY ASSURANCE

A. Installer’s Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

### PART 2 – PRODUCTS

#### 2.1 PIPE INSULATION

- A. Approved Manufacturers: Owens–Corning, Johns–Manville, Knauf, or Certain Teed Co..
- B. Piping, Valves and Fittings to be Insulated Complete as Follows:
  - 1. Domestic cold water except where buried underground.
  - 2. Domestic hot water.
  - 3. Domestic hot water circulating.
- C. Insulation shall be Johns–Manville Micro–Lock 650 or equal. Insulation shall be rigid fiberglass for heating and cooling applications. Sections shall be 3’–0” maximum lengths with snap–on self–sealing, flame–attenuated glass fiber. Vapor barrier jacket shall be AP (all purpose jacket) sealed with adhesive or AP–T (all purpose pressure sensitive jacket) for self–sealing. Pressure sensitive tape as furnished by the Manufacturer shall be used on all butt strips. “K” value ( $(\text{btu}(\text{in.})/(\text{sq. ft.})(\text{degrees F})(\text{hr.}))$ ) at 75 degrees F maximum, shall be equal to 0.25.
- D. All valves and fittings throughout shall be insulated. The Contractor may at his option, use premolded fiberglass PVC fittings installed as recommended by the Manufacturer. PVC Fittings will not be allowed in areas used as a plenum.
- E. The following piping systems shall be insulated.
  - 1. Plumbing: All cold and hot water supply and recirculating lines shall be insulated unless otherwise stated herein or noted on plans.
- F. All insulation shall be applied to pipe with end joints tightly butted and single longitudinal seam closed tightly. Once release paper is removed from the lap, keep free of dirt and water, and seal the lap immediately. After sealing, the lap must be secured by pressing the entire length of lap with a hard plastic squeegee. End joints shall be covered with factory finished vapor barrier tapes secured with adhesive or mastic. At all flanges, fittings, valves and hangers, and at intervals of not more than 12 feet on continuous pipe runs, insulation and vapor barrier shall be sealed to pipe with vapor barrier adhesive or mastic. Hanger rods in direct contact with the pipe shall be insulated separately and sealed off as specified for fittings. Each rod shall be insulated for a distance of 12” upwards from the surface of the pipe insulation.
- G. All Valves, Flanges and Fittings shall be insulated with long textile type glass fiber blanketed insulation wrapped firmly under compression (Minimum 2 to 1) to the thickness of adjoining pipe insulation and held in place by spiral windings of jute twine. A subsequent wrapping of open–mesh cloth or glass fabric tape shall be wrapped over the blanket insulation, over–lapping the adjoining pipe insulation, and heavily coated with vapor barrier mastic.
- H. Thermal Shields for all Insulated Pipe: Provide thermal hanger shields at supports where specified in Section 15140. Provide stickers or color coding indicating that the calcium silicate in the hanger shields is non–asbestos

bearing. Extend insulation insert one inch beyond sheet metal shield. Use double layer shield on bearing surface if pipe hanger spacing exceeds 10 feet. Install vapor barrier mastic at insert/ insulation interface.

I. Thickness Schedule – Fiberglass Insulation

Service	Temp	Branch Runouts less than 12"	½" – 1 – 1/2"	2" – 6"	8" and Larger
Domestic Hot & Hot Water Recirc.	90-	1"	1"	2"	2"
Domestic Cold	50°	1"	1"	1"	1"

J. Protective Covering: New insulation on exposed piping in occupied and exterior insulated piping spaces shall be protected by stainless steel jackets of 0.04" thickness fastened with rivets. Rivets to be installed so as not to be visible when viewing the pipe from a normal position.

2.2 DUCTWORK

- A. Approved Manufacturers: Owens Corning, Knauf, Johns–Manville, Certain Teed Company.
- B. Duct systems listed below are to be insulated as specified herein, on entire lengths of runs, or as noted on the plans.
  - 1. All round and rectangular ductwork.
  - 2. All outside air ductwork.
  - 3. All exposed ductwork including ductwork in Mechanical Rooms.
- C. Flexible Insulation: (Concealed Areas) Duct systems described above located in concealed areas such as vertical duct shafts, crawl spaces, spaces above ceiling, etc. shall be insulated with 1" thick 3lb. density flexible glass fiber insulation having "K" factor not to exceed .25 btu in./(sq.ft.)(degree F) (hr) at 50 degree F mean temperature, and faced with open mesh glass fiber reinforced aluminum laminated fire resistant jacket. Insulation shall be wrapped on ducts with 3" overlapping joints and wired in place with #18 gauge galvanized wire. Metal Corner Angles, 3" X 3" X #26 gauge galvanized iron bent to ¼" radius, shall be placed under wires at all corners.
- D. Rigid Insulation: (Exposed Areas) All exposed metal ducts for outside air shall be insulated with 2" thick 3 lb. density rigid glass fiber insulation having a "K" factor not to exceed .24 BTU of 75 degree F mean temperature.
- E. Exterior Ductwork: Ductwork exposed to ambient conditions shall be insulated with flexible insulation as specified above and shall be covered with 20 gauge sheet metal cover and all seams shall be caulked weather tight with G.E. Silicone Sealer.

- F. Ductwork provided with duct liner as specified in Section 15880 need not be insulated.

## 2.3 INSULATING CEMENTS

- A. Mineral fiber: ASTM C 195.
  - 1. Thermal Conductivity: 1.0 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
  - 2. Compressive Strength: 10 psi at 5 percent deformation.
- B. Expanded or Exfoliated Vermiculite: ASTM C 196.
  - 1. Thermal Conductivity: 1.10 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
  - 2. Compressive Strength: 5 psi at 5 percent deformation.
- C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
  - 1. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
  - 2. Compressive Strength: 100 psi at 5 percent deformation.

## 2.4 ADHESIVES

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
  - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation
  - 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

## 2.5 JACKETS

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber reinforced, flame-retardant kraft paper and aluminum foil.
  - 1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
  - 2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.
- C. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20 mils thick, roll stock ready for shop or field cutting and forming to indicated sizes.
  - 1. Adhesive: As recommended by insulation manufacturer.

- D. PVC Fitting covers: Factory-fabricated fitting covers manufactured from 20 mil thick, high-impact, ultra-violet-resistant PVC.
  - 1. Adhesive: As recommended by insulation manufacturer.
- E. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes.
  - 1. finish and Thickness: Smooth finish, 0.010 inch thick.
  - 2. Moisture Barrier: 1 mil, heat-bonded polyethylene and kraft paper.
  - 3. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

## 2.6 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
  - 1. Tape Width: 4 inches.
  - 2. Cloth Standard: MIL-C-20079H, Type I.
  - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands:  $\frac{3}{4}$  inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: Type 304, 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0,007 inch thick.
  - 4. Brass: 0.01 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 14 gage nickel copper alloy, 16 gage, soft-annealed stainless steel, or 16 gage, soft-annealed galvanized steel.
- D. Corner Angles: 28 gage, 1 inch by 1 inch aluminum, adhered to 2 inches by 2 inches kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

## 2.7 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
  - 1. Water Vapor Permeance: 0.08 perm maximum.
  - 2. Temperature Range: Minus 20 to 180 deg F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
  - 1. Water Vapor Permeance: 0.02 perm maximum.
  - 2. Temperature Range: Minus 50 to 250 deg F.
  - 3. Color: Aluminum.

## PART 3 – EXECUTION

### 3.1 APPLICATION – PIPING

- A. Apply all insulation for thermal purposes on all piping, valve bodies, tees, elbows, equipment, ductwork, etc., as specified and as indicated on the drawings.
- B. Application shall be performed in strict accordance with the best practice of the trade, recommendations of the manufacturer, and the intent of this specification.
- C. Apply insulation over clean, dry surfaces, butting all sections or surfaces firmly together and finishing as required and approved.
- D. Insulation shall extend without interruption through walls, floors, and similar penetrations, except where otherwise indicated.
- E. Provide, where exposed insulated piping pierces walls, floors or ceilings, two inch wide stainless steel bands fitted snugly to the finished surface and held in place on the insulation with sheet metal screws. Screws to be installed so as not to be visible when viewing the pipe from a normal position.

### 3.2 APPLICATION – DUCTWORK

- A. Insulation shall be applied with edges tightly butted, and secured on bottom and sides by impaling on metal clips previously adhered to the ducts with manufacturer's adhesive. Clips shall be spaced not to exceed 18" centers.
- B. Top sides shall be held in place with adhesive. All joints and breaks shall be stripped with tape which is compatible with insulation jacket.
- C. Insulation shall extend without interruptions through walls, floors and similar penetrations, except where otherwise indicated.
- D. NOTE: Insulation shall not be applied until ducts have been inspected or tested for leaks and approved by the Mechanical Engineer. Insulation applied prior to approval shall be removed if so requested by the Engineer. Cost of replacement shall be borne by the Insulation Sub-Contractor.
- E. Exterior ductwork insulation shall be covered with a 20 gauge sheet metal cover for protection from damage and sealed weather tight with G.E. Silicone Sealer.

### 3.3 APPLICATION – EQUIPMENT

- A. Insulation shall be applied with edges tightly butted and secured on bottom sides with manufacturer's adhesive.
- B. All joints and breaks shall be stripped with tape which is compatible with insulation jacket.
- C. NOTE: Insulation shall not be applied until equipment has been inspected or tested for leaks.

**END OF SECTION 15250**

## SECTION 15400 – PLUMBING

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. The work covered under this section consists of furnishing all material, fixtures, and equipment, and all labor necessary to make the installation of the plumbing fixtures, piping and drainage as indicated on the plans and as herein specified.
- B. Types of Plumbing Systems specified in this section include the following:
  - 1. Water Piping
  - 2. Water Supply Specialties
  - 3. Water Heaters
  - 4. Domestic Water Temperature Control
  - 5. Sanitary Drainage Piping
  - 6. Sanitary Drainage Specialties

### PART 2 – PRODUCTS

#### 2.1 WATER PIPING

- A. Pipe Materials: Pipe for various services to be as specified below where otherwise indicated or specified. All pipe to be new, free from dents, scars, or burrs, with ends reamed out smooth.
- B. Water Service Mains Outside of Building 2" and smaller: Type "K" copper, ASTM-B-88, with wrought solder fittings and silver soldered joints.
- C. Domestic Cold, Hot, and Hot Water Circulating Lines Within Building, Above Grade: Copper water tube, ASTM-B-88, Type "L", hard drawn, cast bronze or wrought copper fittings, solder-joint type, using only 95-5 solder.
- D. Domestic Water Lines, Underground, Inside or Outside of Building: Copper water tube, ASTM-B-88, Type "K", hard drawn, with as few joints as possible. Fittings to be cast bronze or wrought copper, solder-joint type using only silver solder. Piping under floors, within building to be located in pipe trenches as indicated on drawings.

## 2.2 WATER SUPPLY SPECIALTIES

### A. Hydrants

1. Approved Manufacturers: Woodford, Josam, Zurn, J.R. Smith, Wade, Chicago Faucet, or approved equal.
2. Hose Bibbs HB-1: Chicago Faucet Co. No. 952, inside sill faucet with vacuum breaker, 3/4" threaded hose outlet, removable tee handle.
3. Sill Cocks SC: Zurn style #Z1300, 3/4" freeze-proof hydrants with removable key, vacuum breaker and lock type cover, hydrant box, nozzle, key control for cover and hydrant.

### B. Water Hammer Arrestors:

1. Approved Manufacturers: Josam, Zurn, J.R. Smith, Wade, or approved equal.
2. Josam Co., Absorption Series # 7500, stainless steel shell, elastomer bellows, pressurized pneumatic cushion. Install where required to prevent shock or water hammer in the cold and hot water piping system. Provide ball valves and access panels at all shock absorber locations as required for access and maintenance. Shock absorbers are as follows:

SA-1	P.D.I. Size "A"	FU = 1 - 11
SA-2	P.D.I. Size "B"	FU = 12 - 32
SA-3	P.D.I. Size "C"	FU = 33 - 60
SA-4	P.D.I. Size "D"	FU = 61 - 113
SA-5	P.D.I. Size "E"	FU = 114 - 154

### C. Thermometers:

1. Approved Manufacturers: Taylor, Trerice, Marsh, U.S. Gauge, or approved equal.
2. Mercury industrial type, 7" scale, 30 degree F to 200 degree F red reading, inclined form, brass case, separable socket. Mount where easily readable from floor.

### D. Pressure Gauge:

1. Approved Manufacturers: U.S. Gauge, Ashcroft, Taylor, Trerice, Marsh, or approved equal.
2. 4-1/2" size, cast aluminum case, phosphor bronze bourdon tube,

monel rotary movement, nylon gears, silver soldered joints, with gauge cock and impulse dampener.

3. Average operating pressure shall fall approximately in the middle of the scale selected.

E. Temperature – Pressure Relief Valves:

1. Approved Manufacturers: Watts, McDonnell–Miller, Cash–Acme, or approved equal.
2. Self–closing, all bronze, set at 100 psi, 210 degree F., ASME approved. Provide copper drain pipe, full size of outlet, extend to floor drain.

F. Backflow Preventers

1. Acceptable Manufacturers: Febco, Watts, Wilkins or approved equal.
2. General: ASSE Standard, backflow preventers, of size indicated for maximum pressure loss where indicated.
  - a. Working Pressure: 150 psig (1035 kPa) minimum except where indicated otherwise.
  - b. 2 Inches (DN 50) and Smaller: Bronze body with threaded ends.
  - c. 2–1/2 Inches (DN 65) and Larger: Bronze, cast–iron, steel, or stainless–steel body with flanged ends.
    - 1) Interior Lining: FDA–approved epoxy coating, for backflow preventers having cast–iron or steel body.
  - d. Interior Components: Corrosion–resistant materials.
  - e. Strainer on inlet.

3. Vacuum Breakers

Hose Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden–hose threads on outlet. Units attached to rough–bronze–finish hose connections may be rough bronze.

4. Reduced Pressure Backflow Preventers

ASSE 1013, consisting of (OS&Y) gate valves on inlet and outlet and strainer on inlet. Include test cocks and pressure–differential relief

valve having ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous pressure application.

- a. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- b. Burp drain funnel.

G. Thermostatic Water-Mixing Valves

1. Acceptable Manufacturers: Lawler, Leonard, Powers, Symmons.
2. General: ASSE 1017, manually adjustable, thermostatic water-mixing valve with bronze body. Include checkstop and union on hot-water and cold-water supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
  - a. Operation and Pressure Rating: Bimetal thermostat, 125 psig minimum.
3. Thermostatic Water-Mixing Valves, Type TMV-1: Unit shall be rated for a minimum capacity of 8 GPM with a 45 PSI pressure drop. Include options as indicated.
  - a. Piping with check stops, valves and unions in arrangement to permit easy removal.
  - b. Piping Component Finish: Rough brass.
  - c. Discharge temperature gauge.

H. Insulating Bushings:

1. Approved Manufacturers: EPCO or approved equal.
2. Provide dielectric insulating bushings wherever piping connects to dissimilar metals.
3. Waterway nipples.

2.3 WATER HEATERS COMMERCIAL – POWER GAS FIRED HIGH EFFICIENCY

- A. Approved Manufacturers: Ruud, A.O. Smith, State Stove Co., Lockinvar, PVI, or approved equal.
- B. General: Provide power gas-fired NSF water heaters of sizes and capacities as indicated on schedule.
- C. Heater: Construct for working pressure of 160 psi; 3/4" tapping for relief

valve; fluorocarbon polymer lining applied and baked in three separate coatings on internal surfaces exposed to water.

- D. Safety Controls: Equip with automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank; and pilot safety shutoff.
- E. Burner: UL rated power burner with blower motor with solid state electronic flame safeguard system requiring 110V external power upper and lower operating thermostats, temperature limiting device, temperature and pressure gauges and low water cutoff.
- F. Jacket: Insulate tank with vermin-proof foam insulation. Provide outer steel jacket with baked enamel finish.
- G. Accessories: Provide brass drain valve; 3/4" ASME T&P relief valve; as well as standard equipment as listed on Manufacturer's Specification Sheet.
- H. Controls: Provide gas pressure regulator; pilot gas regulator; and adjustable thermostat.

#### 2.4 DOMESTIC WATER TEMPERATURE CONTROL

- A. Approved Manufacturers: Leonard, Powers or approved equal.
- B. Provide 3-way mixing valves in the hot water discharge line to mix hot water and cold water as modulated by the aquastat to provide supply water temperature as indicated on the drawings.

#### 2.5 NATURAL GAS SYSTEM

- A. Refer to Section 15488 for Natural Gas Piping and equipment

#### 2.6 SANITARY DRAINAGE PIPING

- A. Building Sewers (below grade within building) to a Point 5'-0" Outside of Building: Cast iron soil pipe, service weight Class B, ASTM-A-74. Fittings shall correspond to pipe in material, strength, ASTM standards. Ten foot lengths of cast iron pipe shall be used wherever possible to minimize the number of joints in the system. All cast iron soil pipe and fittings to be labeled with the "Cast Iron" mark of quality and performance as illustrated in Commercial Standard CS-188-59. All pipe and fittings to be tar-coated.
- B. Joints for cast iron soil pipe and fittings with hubs and plain end spigots shall be made by using positive double seal elastomeric compression-type gaskets conforming to ASTM C-564.

- C. Manhole: Contractor to provide manholes as required. Refer to details on plans.
- D. Building Sewers Below Grade More Than 5 Ft. from Building: See 'Civil Drawings'.
- E. Soil, Waste, Vents, Drains Above Ground: Cast iron, ASMT-A74, service weight, hub-and-spigot soil pipe and fittings, or CISPI Standard 301, hubless cast iron soil pipe and fittings with neoprene gaskets.

## 2.7 SANITARY DRAINAGE SPECIALTIES

- A. Cleanouts:
  - 1. Approved Manufacturers: Josam, Zurn, J.R. Smith, Wade, Jones Spec or approved equal.
  - 2. Finished Floors: Zurn ZN-1400-2 with nickel bronze non-slip scoriated square access cover set flush with floor.
  - 3. Unfinished Floors and Outside Areas: Zurn 1420-25 with non-slip scoriated access cover, set flush with floor or surface. In nonsurfaced areas they shall be cast in 14" X 14" X 8" deep concrete block set flush with finished grade, or provided with concrete ring and cover.
  - 4. Finished Walls: Zurn Z-1400-1 or Z-1400 in soil lines or Z-1400-1 in IPS lines, covered with nickel-bronze access cover, 8" X 8" openings, flush with finished wall.
  - 5. Unfinished Walls and Accessible Concealed Spaces: Zurn Z-1400 in soil lines, or Z-1400-1 in IPS pipe lines.
- B. Trap Primers: Bronze body valve with automatic vacuum breaker, with 1/2 inch connections matching piping system. Complying with American Society of Sanitary Engineering (ASSE 1018).
- C. Flashings:
  - 1. Flash vents and roof drains with 4 lb. lead.
  - 2. The base of the flashings shall be minimum 12" X 12" on the roof for 2" and 3" vents, 18" X 18" for 4" vents.
- D. Sand-Oil Interceptor:
  - 1. Approved Manufacturers: Copeland Concretes, ARCO Concretes, Inc., or approved equal.

2. General: Provide Class A, concrete, precast grease trap for the trench/floor drain system mounted outside of building, with cover extended to flush with grade, steel frame and bolted gas-tight steel cover. Capacity to be as scheduled and detailed on the drawings. REFER TO CIVIL DRAWINGS FOR ADDITIONAL REQUIREMENTS.

E. Drains:

1. Approved Manufacturers: Josam, Zurn, J.R.Smith, Wade, Western, Jones Spec or approved equal. Provide back water valves on all floor drains below finished grade.
2. Floor Drains, General Finished Areas (FD-1): Zurn Z416-P-5 5x5, cast iron, nickel-bronze polished strainer, flashing clamp device, deep seal trap. On all floor drains noted (FD-IT) provide trap primers. All floor drains in tile floors to be square with secured heel-proof grate.
3. Floor Sink (FS-1): ZurnZ1980, 12x12 sanitary floor sink, cast iron, white porcelain enameled inside, anti-splash slotted nickaloy dome strainer. Provide gratings as shown on the drawings.

## PART 3 – EXECUTION

### 3.1 EXCAVATION

- A. Underground piping or sewers shall not be installed where new excavation occurs until after earth has been filled, tamped, and compacted to rough grade by General Contractor.
- B. After compacting and rough grading have been completed, new trenches shall be dug down to required levels for the installation of new underground piping and sewers. Where no new excavation occurs, trenches may be dug at the time of installation of the new piping is ready to occur.
- C. The Plumbing Contractor shall provide depressions in earth under all pipe bells to ensure uniform bearing.
- D. Where rock is encountered, excavate to 3" below bell of pipe and provide bed for refilling with sand and gravel to common level of pipe. Bed shall be well compacted by tamping with heavy tamper.
- E. Remove all surplus material removed from excavation.

### 3.2 BACKFILLING

- A. Trenches shall be backfilled only after underground piping has been tested, inspected, and approved. Backfill trenches as specified herein.

- B. Trenches shall be backfilled in thin layers with sand or clean earth free of debris such as cinders, brickbats, etc., up to 12" above top of pipe by the Plumbing Contractor. Remaining fill layers shall be well compacted and may be performed by tamping with heavy tamper devices such as graders, bulldozers, etc.
- C. This Contractor shall ensure permanent stability of the piping installed and that sufficient compacting has been accomplished to ensure elimination of ground movement as specified.
- D. Any existing finish material such as concrete, asphalt, etc., that has been removed due to trenching, shall be replaced to finish grade and shall match existing finishes.

### 3.3 WATER SUPPLY SYSTEM

- A. Provide sleeve for water service entry through foundation wall, make entry water-tight.
- B. Service to be a minimum of plus 12" below applicable frost line. (Refer to Civil Drawings)
- C. Immediately install water service, provide temporary (frost proof) outlet with hose valve outside building for construction purposes.
- D. Building Piping: Provide a complete piping system in building from valve on service to all fixtures and equipment outlets requiring a cold and/or hot water supply. All branch mains and connections to risers shall be valved and drip cocks provided so that the entire system may be drained. Provide swing or swivel joints on connections from mains to risers, from risers to branches, with loops, bends, expansion joints, guides, anchors, as required to prevent noise or vibration of piping due to pipe expansion contractions or shock. Provide fixture stops at all fixtures, and shut-off valves at all branch take-offs, hose bibbs, wall hydrants, etc., so that entire system does not need to be shut off when replacing or servicing of fixtures and hydrants.
- E. Damage by Leaks: Plumbing Contractor shall be responsible for damages to the grounds, walks, roads, buildings, piping systems, electrical systems, and their equipment and contents, caused by leaks in the piping systems being installed or having been installed herein. He shall repair at his expense all damage so caused as directed by the Architect. The Owner reserves the right to make emergency repairs as required without voiding the Contractor's Guarantee Bond nor relieving the Contractor of his responsibility during the bonding period.
- F. Hangers and Supports: As specified in Division 15, Section 15140, "Supports, Anchors and Hangers".

- G. Valves: As specified in Division 15, Section 15100, "Valves".
- H. Install all water specialties in conformance with local codes and ordinances and as recommended by the manufacturers.

### 3.4 ADJUSTING AND CLEANING

- A. Clean and Disinfect Water Distribution Piping As Follows:
  - 1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.
  - 2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority the procedure described in either AWWA C601, or AWWA D105, or as described below:
    - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
    - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
    - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming for the system, less than 1 part per million. Operate all faucets and outlets.
- B. Prepare reports for all purging and disinfecting activities.

### 3.5 GAS-FIRED WATER HEATERS

- A. General: Install water heaters in accordance with manufacturer's installation instructions, Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturers' recommended clearances.
- B. Support: Place units on concrete pads, orient so controls and devices needing service and maintenance have adequate access.
- C. Piping: Connect hot and cold water piping to units with shutoff valves and unions. Connect recirculating water line to unit with shutoff valve, check

valve, and union. Extend relief valve discharge to closest floor drain, or as indicated.

- D. Gauges: Provide thermometers on inlet and outlet piping of water heaters, in accordance with Basic Mechanical Materials and Methods Section "Meters and Gauges."
- E. Gas-Fired Water Heaters: Connect gas supply to gas line with drip leg, tee, gas cock, and union; full size of unit inlet connection. Locate piping so as not to interfere with service of unit.
- F. Flue: Connect flue to unit with gas-tight connection. Provide flue of minimum size as flue outlet on heater. Comply with gas utility requirements and manufacture's installation manual and requirements.

### 3.6 GAS PIPING SYSTEM

- A. General: Provide all gas piping from the gas meter to all gas outlets and equipment requiring gas connections. Reference Section 15488 Natural Gas Piping Systems.

All exposed gas piping shall be painted.

### 3.7 SANITARY DRAINAGE PIPING

- A. Obtain permit from agency having jurisdiction, provide building sewer, connect to building drains as shown.
- B. Provide complete sanitary system including all fixtures traps, vents, soil and waste piping, rough-ins and connections as shown or specified. Provide back water valves for all drains below grade line.
- C. Lines, Grades: Lay piping true to line and grade, so that sewer will have a uniform invert throughout its length. Grade piping by measuring with rod from overhead grade line set horizontal and held taut between grade bars to prevent sagging. Contractor to verify elevations of existing sewer before starting work. Unless otherwise indicated or directed, maintain 30" minimum cover above piping. All drainage piping inside of building shall have a minimum of 1/8" per foot in direction of flow.
- D. Joints for cast-iron bell and spigot soil pipe shall installed sp per CISPI Standards. No paint, varnish, or other coating shall be permitted on the jointing material until after the joint has been tested and approved. "No-Hub" fittings may be used above grade where approved by Building Department. "No-Hub" fittings not acceptable below grade.
- E. Note: All sewer lines installed at a depth of less than 4'-0" below grade and under areas that normally receive vehicular traffic shall be extra heavy cast

iron sewer pipe.

- F. Piping shall be installed so as to eliminate any noise from expansion and contraction of copper pipe. Install expansion joints if necessary. Hubless piping on all waste lines above floors may be used at Contractors option. Install per Manufacturer's requirements.

### 3.8 SANITARY DRAINAGE SPECIALTIES

#### A. Cleanouts:

- 1. Provide cleanouts at all bends, angles, upper terminals, and not over 50 feet apart in any lineal run of indoor piping. Cleanouts shall be spaced at 100 feet apart outdoors. All shall be accessible or be extended to the floor above, or outside of building. Provide accessible cleanouts at all fixtures, full size of fixture drain line.
- 2. Cleanouts to be full size of the pipe line in which they are installed up to and including 4" size, and in lines over 4" in size, they shall be 4".

#### B. Flashings:

- 1. Vents through roof terminate 1'-0" above roof.
- 2. Extend vent line flashing around pipe and over top, 2" beat down in pipe one inch.
- 3. Flashing bent down into vent piping, not required if EPDM Roofing System is used.

#### C. Floor Drains & Floor Sinks:

- 1. The floor drains and floor sinks shall be installed in accordance with manufacturer's instructions and details.
- 2. Install floor drains and floor sinks at low point of surface areas to be drained or as indicated. Set tops of drain strainers flush with finished floors.

### 3.9 TESTS FOR PLUMBING AND DRAINAGE SYSTEM

- A. Test all plumbing work as specified below and according to local code regulations. All tests shall maintain the pressure specified for a 1/2 hour minimum duration without pumping.
- B. Sectionalizing: Piping may be tested a section at a time in order to facilitate the construction.

- C. All hot and cold water lines shall be capped or plugged and tested at 50 PSIG hydrostatic test above operating pressure and proved tight before any piping is covered or concealed in any part of the building construction. Fill the section of pipe to be tested with water and bring the section up to pressure with a test pump. The tests shall be conducted by the Contractor in the presence of the Architect. These tests shall be conducted before any insulation is installed and any insulation installed prior to these tests shall be removed. Gages used in the tests shall have been recently calibrated with a dead weight tester. All tests shall apply full test pressure to the piping for a minimum of twenty-four hours.
- D. All soil, storm, waste, and vent piping within the building shall be tested to a 10 lb. hydrostatic test, and all joints inspected while under pressure.
- E. All soil, waste, and vent piping which occurs outside the building area shall be tested to a minimum of 10 feet of pressure head. Each joint shall be water-tight after 15 minutes.
- F. All piping shall be tested and proved to be tight before being concealed in the building construction.
- G. Before final acceptance of the system as a whole, this Contractor shall make all adjustments as required and place the entire plumbing system in perfect operating condition.
- H. At the completion of this work, the Contractor shall furnish to the Architect all required Certificates of Inspection.

### 3.10 COMMISSIONING

- A. Fill the System:  
  
Check systems to determine that they are not air bound and that the system is completely full of water.
- B. Before Operating the System Perform These Steps:
  - 1. Open valves to full open position. Close drain, valves, hydrants, and sill cocks.
  - 2. Remove and clean strainers.
  - 3. Check pump for proper direction of rotation. Correct improper wiring.
  - 4. Lubricate pump motors and bearings.
  - 5. Adjust flows to plumbing fixtures.

**END OF SECTION 15400**

## SECTION 15450 – PLUMBING FIXTURES & TRIM

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

The work covered under this section consists of furnishing all fixtures and trim and all labor necessary to make the installation of the plumbing fixtures, as indicated on the plans and as herein specified.

### PART 2 – PRODUCTS

#### 2.1 PLUMBING FIXTURES

##### A. Approved Manufacturers:

##### 1. Plumbing Fixtures:

- a. Kohler
- b. American Standard
- c. Crane
- d. Zurn
- e. Fiat
- f. Sterns-Williams
- g. Toto

All Fixtures and Trim shall be of the same Manufacturer, as close as possible.

##### 2. Trim Manufacturers (as specified for fixtures):

- a. Speakman
- b. Delta
- c. Chicago Faucet
- d. Kohler
- e. Crane
- f. Toto

##### 3. Flush Valves (as specified for fixtures):

- a. Sloan
- b. Watrous
- c. Zurn
- d. Delaney
- e. Toto

4. Seats:

- a. Church
- b. Olsonite
- c. Beneke
- d. Bemis

Seats shall be solid plastic type, color to match fixture.

5. Electric Water Coolers and Drinking Fountains

- a. Haws
- b. Halsey Taylor
- c. Sunroc
- d. Cordley
- e. Oasis

- B. All exposed pipe shall be chrome plated.
- C. All exposed screws (faucets, valves, etc.) to be vandal-proof type.
- D. All fixtures shall be white unless otherwise noted.

## 2.2 PLUMBING FIXTURE LIST

Refer to FIXTURE SCHEDULE on drawing sheet P2.1 for basis-of-design manufacturer and model number.

### Water Closets (Tank Type)

Vitreous china floor set elongated rim siphon jet action, (1.6 gal/flush) tank type complete with backflow preventer, commercial stain resistant seat for elongated bowl, open front, less cover with stainless steel check hinge. 3/8" supply with I.k. stops.

### Water Closets (ADA-compliant Tank Type)

Vitreous china elongated rim siphon jet action, (1.6 gals/flush) tank type, 18" high complete with backflow preventer, commercial stain resistant seat for elongated bowl, open front less cover with stainless steel check hinge. 3/8" supply with I.k. stops. Provide flush lever on open side of stall.

### Lavatory (Countertop-Oval/Round)

Self-rimming, oval vitreous china lavatory. Thermal mixing, battery powered (3vdc) sensor faucet, 4"centers with cover plate with 10 second cycle 0.17 gallons of water per cycle, lavatory faucet, aerator, open grid drain. 3/8" c.p. flexible supplies with l.k. stops. 1-1/4" cast brass "P" trap with cleanout.

Lavatory (ADA-compliant Countertop-Oval/Round)

Self-rimming, oval vitreous china lavatory. Thermal mixing, battery powered (3vdc) sensor faucet, 4"centers with cover plate with 10 second cycle 0.17 gallons of water per cycle, lavatory faucet, aerator, open grid drain. 3/8" c.p. flexible supplies with l.k. stops. 1-1/4" cast brass "P" trap with offset tail piece for wheelchair access. Provide TRUEBRO, Handi Lav-Guard, pre-molded insulation kit for exposed water and waste piping below lavatory. Include insulation on stop valves, P-traps, tailpiece, piping, fittings, etc. for protection against burning and cushion impact.

Urinal (+24 AFF to Rim)

0.125gpf ultra low-consumption, vitreous china washout wall-hung urinal. Floor mounted wall carrier, concealed type. Sensor operated battery powered exposed high efficiency flush valve, control stop assembly.

Drinking Fountain (ADA-compliant)

ADA compliant, stainless steel wall hung surface mounted drinking fountain complete with stainless steel back panel, mounting plate and floor mounted chair carrier. Unit shall have push button operator, automatic valve regulator, screwdriver stops, self-closing valve, and trap. Mount unit 33" to top (27" min. to bottom of unit).

Service Sink (Mop Service Basin)

24" x 24" x 10" high, molded stone mop basin with 3" chrome drain, stainless steel rim guard and backsplash catcher panels of 20 gauge type 304 stainless steel. Faucet with pail hook, threaded hose connection, vacuum breaker and adjustable wall brace. Provide "P" trap.

## **PART 3 – EXECUTION**

### **3.1 PLUMBING FIXTURES**

- A. Fixtures shall be delivered to the job and the Architect notified in sufficient time so that inspection before installation may be made without delaying the progress of the work. The Contractor is fully responsible for protection of fixtures before and after inspection until final acceptance of the entire building by Owner. Any damaged fixtures shall be immediately replaced by this Contractor regardless of who caused the damage.
- B. All fixtures shall be securely mounted to walls and floors.
- C. Rough-in only hot and cold water, gas, waste, vent, soil, drainage piping to all fixtures and equipment as well as fixtures and equipment furnished

by General Contractor and/or Owner as shown on drawings. Provide fixture stops and "P" traps as required for all plumbing fixtures. Coordinate locations, sizes, etc. with equipment drawings and schedule.

- D. Contractor shall be responsible for all incidental parts for both new and existing equipment to provide a complete and operating systems.

### 3.2 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.
- B. Comply with the installation requirements of ANSI A117.1 and Uniform Building Codes with respect to plumbing fixtures for the physically handicapped.
- C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
- D. Install a stop valve in an accessible location in the water connection to each fixture. Install access panels in wall for access to concealed stop valves.
- E. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.
- F. Seal fixtures to walls and floors using silicone sealant as specified in Section 07900. Match sealant color to fixture color.

### 3.4 FIELD QUALITY CONTROL

- A. Test fixtures to demonstrate proper operation upon completion of

installation and after units are water pressurized. Replace malfunctioning units, then retest.

- B. Inspect each installed unit for damage. Replace damaged fixtures.

### 3.5 ADJUSTING

- A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.
- B. Replace washers of leaking or dripping faucets and stops.

### 3.6 CLEANING

Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures, drinking fountains, and trim.
- B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

**END OF SECTION 15450**

## SECTION 15488 – NATURAL GAS SYSTEMS

### PART 1 – GENERAL

#### 1.1 SECTION INCLUDES

- A. Natural gas piping

#### 1.2 GENERAL

- A. Arrange with Utility Company to provide gas service to and including gas meters. Consult with Utility Company as to the extent of its work, costs, fees, permits involved, and pay for all such costs and fees. Obtain all required permits.
- B. All work shall be in strict conformance to all local and national fuel gas codes, and be installed to the requirements of the local gas utility company.

#### 1.3 INSTALLATION

- A. All underground piping shall be outside of buildings shall be machine wrapped with “Scotchwrap” PVC tape using 50% overlap as minimum.
- B. All gas piping run in dedicated air plenums, or in areas noted on the drawings shall be of all welded construction, irregardless of sizes.
- C. Note: Gas piping is sized on 14 inches W. C. minimum, unless noted otherwise on the drawings. The Contractor shall furnish and install additional pressure regulators to reduce gas pressure from 14 inches W.C. to required pressure at each gas burning appliance as required.
- D. Contractor shall verify gas requirements for all gas burning equipment before running any piping.

#### 1.4 SUBMITTALS

- A. Product Data
  - 1. Natural Gas Piping
- B. Quality Assurance Data
  - 1. Welding
    - a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 2. Electrical Components and Devices
    - a. Listed and labeled as defined in NFPA 70. Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. NFPA Standard
    - a. Comply with NFPA 54, "National Fuel Gas Code".
- C. Project Record Documents
  - 1. Shop Drawings
    - a) Gas piping system layout, including each gas load connected to the system.
    - b) Certified elevation and outline drawings with dimensions
    - c) Certified plan view drawings with dimensions
    - d) Wiring and termination drawings
- D. Pipe Identification
  - 1. Natural gas piping located outside the building shall be painted.

2. Natural gas piping located inside the building shall be identified to match existing scheme in building.

## PART 2 – PRODUCTS

### 2.1 PIPING MATERIALS

#### A. Interior Exposed or Accessible

1. Size ½” through 1-1/2”
  - a) Pipe: Schedule 40, ASTM A120
  - b) Fittings: Threaded malleable iron
  - c) Joint Seal: Rector seal or Teflon paste
  - d) Unions: Black malleable iron ground joint, bronze to iron seat, 150 lb. class, ANSI B2.1 and ASTM A197
2. Size 2” and over
  - a) Pipe: Schedule 40, ASTM A53, Type S, Grade B
  - b) Fitting: Butt weld ASTM A234
  - c) Unions: 150 lb. forged steel weld neck flange, ANSI/B16.5 and ASTM A105
3. ASTM-A1-6 welding fittings shall be used for all gas piping 2” and larger.

### 2.2. VALVES

#### A. Gas Cocks ¾” and Smaller:

1. 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends. Crane Company, No. 1228 or equal.
- B. Gas Cocks 1" and Larger:
1. 175 psi, lubricated plug type, semi-steel body, single gland, wrench-operated, flanged ends. DeZurik Series 400, or equal.
- C. Note: Gas piping sized on 14 inches W.C. minimum. Contractor shall furnish an additional pressure regulator to reduce gas pressure from 14 inches WC to required pressure at each gas-burning appliance as required.

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- A. Basic piping installation requirements are specified in Specification Section 15010, Basic Mechanical Materials and Methods.
- B. Concealed Locations:
1. Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
- C. Above-Ceiling Locations:
1. Gas piping may be installed in accessible spaces, subject to approval of the Denver Building Department, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
- D. In Floors:
1. Gas piping shall not be installed in floors.
- E. In Floor Channels:

1. Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
- F. In Partitions:
1. Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
  1. Exception: Tubing passing through partitions or walls.
- G. In Walls:
1. Do not install gas piping in exterior walls.
  2. Exception: Tubing passing through partitions or walls.
- H. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
1. Exception: Accessible above-ceiling space specified above.
- I. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of three pipe diameters, but not less than three (3) inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- J. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.

1. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
2. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
3. Connect branch piping from top or side of horizontal piping.
4. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
5. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
6. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
7. Select location of gages from options in first paragraph below or delete.
8. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.

### 3.2 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Specification Section 15010, Basic Mechanical Materials and Methods.
- B. Use materials suitable for fuel gas.
  1. Brazed Joints: Make with brazing alloy with melting point greater than 1000°F. Brazing alloys containing phosphorus are prohibited.

- C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Specification Section 15050, Basic Mechanical Materials and Methods.

**END OF SECTION 15488**

## SECTION 15860 – HVAC EQUIPMENT

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. Work of this section generally includes provisions of fans, ductwork, flues, air outlets and inlets, terminal boxes, equipment and accessories related to air distribution systems.
- B. Types of Air Distribution Systems specified in this section include the following:
  - 1. Ceiling Exhaust Fans
  - 2. Sidewall Propeller Exhaust Fans
  - 3. Gas-fired Unit Heaters
  - 4. Makeup Air Units
  - 5. Vehicle Fume Exhaust System
  - 6. Gas-Fired Infrared Radiant Heaters
  - 7. Indirect Evaporative Coolers

#### 1.3 QUALITY ASSURANCE

- A. General:
  - 1. Performance Rating: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300.
- B. Reference Standards:
  - 1. AMCA 99 Standards Handbook.
  - 2. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes.
  - 3. AMCA 300 Test Code for Sound Rating Air Moving Devices.
  - 4. AMCA 301 Method of Calculating Fan Sound Ratings from Laboratory Test Data.

5. SMACNA Low Pressure Duct Construction Standard.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300 and Section 15010.
- B. Provide product data on centrifugal fans and accessories as required for the work.
- C. Provide fan curves with specified operating point clearly plotted.
- D. Submit sound power levels for both fan inlet and outlet at rated capacity.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data per Section 01350 and 01700.
- B. Include instructions for lubrication, motor and drive replacement, spare parts lists, and wiring diagram.

**PART 2 – PRODUCTS**

2.1 GENERAL DESIGN CRITERIA

- A. Fans used shall not decrease in motor size, increase noise level, or increase tip speed by more than 10% or increase inlet air velocity by more than 20% for specified criteria. Fans shall be capable of accommodating static pressure variations of 10%.
- B. All gas fired equipment shall be AGA approved for use with natural gas on indoor and/or outdoor equipment.
- C. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.
- D. See Equipment Schedule on the drawings for capacities to specified units.

2.2 CEILING OR IN-LINE EXHAUST FANS

- A. Approved Manufacturers: Greenheck, Acme, and Cook or approved equal.
- B. Type: The ceiling exhaust fans shall be of the centrifugal fan, integral grille and housing type, with solid state variable speed controller, all completely self-contained.
- C. Capacity: The capacity and model number of the units shall be as shown on drawings, and shall be certified by AMCA.

- D. Fan: The fan shall be of the true centrifugal wheel design.
- E. The Housing shall be constructed of heavy gauge steel, completely insulated internally with acoustical insulation material to deaden sound.
- F. Each Fan to be equipped with a backdraft damper, inlet grille, discharge duct, roof, wall, or eave cap as indicated, and shall be UL approved.
- G. Note: RPM of fans schedules shall be considered as maximum.

### 2.3 SIDEWALL PROPELLER EXHAUST FANS

- A. Approved Manufacturers: Greenheck, Acme Co., Cook, or approved equal.
- B. Description: Belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.
- C. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - 1. Service Factor Based on Fan Motor Size: 1.4.
  - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
  - 5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  - 7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.4 GAS-FIRED UNIT HEATERS

- A. Acceptable manufacturers: Lennox, Modine, Reznor, Sterling
- B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- D. Type of Venting: Indoor, separated combustion, power vented.
- E. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
  1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
  2. Suspension Attachments: Reinforce suspension attachments at connection to fuel-fired unit heaters.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Unit Fan: Steel, centrifugal fan dynamically balanced and resiliently mounted.
  1. General requirements for motors are specified in Division 15050.
  2. Motors: Totally enclosed with internal thermal-overload protection.
- I. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

1. Gas Control Valve: Single stage.
  2. Ignition: Electronically controlled electric spark with flame sensor.
  3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  4. Vent Flow Verification: Differential pressure switch to verify open vent.
  5. Control transformer.
  6. High Limit: Thermal switch or fuse to stop burner.
  7. Thermostat: Single-stage, wall-mounting type with 50 to 90 deg F operating range and fan on switch.
- J. Discharge Louvers: Independently adjustable horizontal blades.
- K. Accessories:
1. Vertical discharge louvers.
  2. Four-point suspension kit.
  3. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.

## 2.5 MAKE-UP AIR UNITS

- A. Approved Manufacturers: Greenheck, Modine, Sterling or Reznor.
- B. Fabrication:
1. Construct heater casing components of 18-gauge steel panels, reinforced with angles and channels to ensure rigidity under handling. Provide access panels to burner and blower motor assemblies.
  2. Insulate complete unit with one-inch neoprene faced glass fiber insulation.
  3. Finish casing and components with heat resistance baked enamel.
- C. Filter Mixing Box:
- Provide a filter mixing box section which shall include one inch thick, throwaway filters housed within a metal frame and low-leak outside and return air motorized dampers. Outside air damper shall be normally closed

and return air damper shall be normally open. Filter efficiency shall be 30% minimum based on the ASHRAE Test Standard 52-76.

D. Burner:

1. Gas burner shall be power gas, with integral combustion air proving switch and positive combustion air supply.
2. Provide gas burner suitable for natural gas and capable of modulating turn down ratio of 25:1. Burner assembly and gas piping arrangement shall include electric modulating main gas valve, motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve, and manual pilot adjustment valve.
3. Furnish gas burner with electrically ignited supervised pilot. Pilot automatically ignited by spark rod through high voltage ignition transformer. Lockout device stops gas flow to pilot if the pilot fails to light in 120 seconds. Reset of lockout requires manual interruption of the thermostat circuit.
4. Provide motorized damper complete with end switch to prove position before burner will fire.

E. Heat Exchanger:

Heat exchanger tubes shall be 14-gauge 409 stainless steel without internal baffles and with stainless steel tips. Heat exchanger shall be indirect fired.

F. Fan:

Provide statically and dynamically balanced radial blade fan mounted on solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.

G. Controls:

1. Pre-wire unit so connection of power supply and field power wiring and controls to remote wall temperature/fan controller shall make unit operational.
2. A factory installed control box or junction box shall be provided for all power connections. A 24 volt control transformer and high limit switch shall be provided.
3. Furnace shall be provided with gas valve suitable for Class 2, maximum inlet pressure of 0.5 psi (14-inch W.C.) on natural gas. The 24 volt combination automatic gas valve shall include a main

operating valve, pilot safety shutoff, pressure regulator, manual main and pilot shutoff valve, and adjustable pilot valve.

4. Electronic Modulating gas valve. Unit shall be provided with modulated heat output. Ignition shall be at low fire (one-half rate of input), and a temperature sensor shall modulate the gas input from 20 to 100 percent rated input. Unit shall be provided with an automatic valve in series with the electronic valve to cycle the unit.

## 2.6 VEHICLE FUME EXTRACTION EXHAUST SYSTEM

- A. Approved Manufacturers: Nederman, Inc., or prior approved equal.

The system specified and design shall serve as the basis of design. Approved equal manufacturers shall clearly identify deviations from this specification and drawing and include the description of the deviations in their bid.

- B. Flexible Hose: Hose shall be flexible exhaust hose manufactured for the sole purpose of venting high temperature exhaust gases, which are produced by internal combustion engines. The flexible hose shall be designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe. Hose shall range from 3" – 5 " diameters with varying lengths depending on the system length required ranging from 20 – 43 feet without joining or splicing connections. Hose material shall be high temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2 7/16". This construction of hose must be capable of operating at continuous temperatures of 400 degrees F and intermittent temperatures of 500 degrees F such as are experienced when pump checks are performed inside the station. Wire Helix shall be bound and protected in laminations of hose winding. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. Wear strip shall be 9/16" wide and be provided as a safety yellow color. The bend radius of the high temperature hose shall be no less than 1.5 times the diameter of hose to ensure that hot gases are not restricted as they pass through the system.
- C. Collection Nozzle Assembly: The nozzle shall provide a substantially air tight seal around exhaust tail pipe when connected thus allowing for source capture. The seal shall not allow for escape of life threatening exhaust gases.
- D. Controls: The control assembly shall be furnished complete to the installer for installation and wiring. The controls shall be wired in conformance with the manufacturer's requirements to provide a complete workable system to function per the manufacturer's requirements.

1. The auto-start control system shall be provided consisting of a pressure sensor(s), temperature sensor(s) and control panel.
2. The control panel shall have functions for manual and automatic start/stop of the exhaust fan. The control panel shall energize the exhaust fan upon a signal from any one of the pressure and/or temperature sensors.
3. The pressure sensor shall react to increasing pressure (positive pressure) in the system upon the start-up of the vehicle/apparatus. The pressure sensor shall be adjustable to fit all engine sizes.
4. The temperature sensor shall react to increasing temperature in the system when the vehicle/apparatus is running. The temperature sensor shall be adjustable to fit all engine sizes.
5. The control panel shall have a 7-second to 6-minute timer that allows the exhaust fan to run for a pre-determined time. The exhaust fan run time shall be easily adjustable. The control panel shall activate the exhaust fan through a motor starter.

## 2.7 RADIANT GAS FIRED HEATING UNITS

- A. Approved Manufacturers: Re-Verber-Ray, Roberts-Gordon or Solaronics.
- B. Finish and install. Capacities shall be as scheduled on the drawings. Units shall be designed to operate on natural gas at 5200 ft. elevation.
- C. Nominal system electrical characteristics shall be as scheduled. Each unit shall be capable of satisfactory operation within voltage range. Units shall be certified by the American Gas Association.
- D. Burners and Controls: Burners shall be designed to fire simultaneously in series without adverse effects from combustion gases from upstream burners. Fail safe operation shall allow system to preclude gas if main gas valve fails to open, vacuum pump motor fails to operate, or upon power failure. Radiant gas units shall operate under negative pressure at all times during operation. Units shall be furnished complete with room thermostat, burner assembly with cast iron burner heads, pre-wired gas controls, electronic three-try spark ignition, combustion air filters, regulator, gas valve, and all required safety valves required by UL or AGA compliance.
- E. Heat Exchanger: Radiant tubing between burners and ten to seventy feet downstream of last burner shall be 4" steel or heat-treated aluminized tubing. Remainder of tubing shall be 4" steel tubing with internal coating of acid-resisting porcelain. All heat exchanger tubing connections shall be made with stainless steel coupling assemblies. Unlined couplings shall be used with uncoated tubing or to connect uncoated to coated tubing. Lined couplings shall be used to connect coated to coated tubing.

- F. System Control: All burners shall be pre-wired with grounded electrical cord and plug. An electronic solid-state control panel to facilitate zone temperature control for the various zones.

## 2.8 INDIRECT EVAPORATIVE COOLER

- A. Acceptable Manufacturer: Coolerado
- B. The basis-of-design is the Coolerado Model M30. Any other product wishing to bid shall meet or exceed the specifications of the basis-of-design product. Manufacturers other than the basis-of-design shall submit for approval by the Engineer prior to submitting a bid.

## PART 3 – EXECUTION

### 3.1 INSPECTION

Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

### 3.2 INSTALLATION

- A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.
- C. Duct Connections: Connect ductwork to air terminals in accordance with Division 15 ductwork sections.
- D. Install roof curb in accordance with details on drawings and as specified in Division 7.
- E. Installation and connection of gas-fire heaters and associated fuel and vent features and systems installed and connected in accordance with NFPA 54, applicable local codes and regulations, and manufacturer's printed installation instructions.
  - 1. Connect gas piping in accordance with Division 15 Section "Natural Gas Systems".
  - 2. Connect vents and intake in accordance with the manufacturer's installation instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.
- B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

### 3.4 IDENTIFICATION

Identify heaters and connections in accordance with Division 15 Section "Mechanical Identification".

### 3.5 COMMISSIONING

- A. Test functions, operations, and control sequences and protective features. Adjust to assure operation is in accordance with design.
- B. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

### 3.6 CLEANING AND ADJUSTING

- A. **Cleaning:** Upon completion of installation, inspect equipment and associated components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.
- B. **Adjusting:** Make unit adjustments for optimum performance and efficiency. Adjust distribution features, including louvers, vanes, shutters, dampers, and reflectors, to provide optimum distribution for objects, personnel, and spaces served.

**END OF SECTION 15860**

## SECTION 15880 – AIR DISTRIBUTION

### PART 1 - GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. Work of this section generally includes provisions of fans, ductwork, flues, air outlets and inlets, terminal boxes, equipment and accessories related to air distribution systems.
- B. Types of Air Distribution Systems specified in this section include the following:
  - 1. Sheet Metal and Accessories
  - 2. Ductliner Insulation
  - 3. Round Flexible Ductwork
  - 4. Registers, Grilles and Diffusers

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL WORK AND ACCESSORIES

- A. Access Door Hardware: Ventlok Series 100 latches, hinges, and gasketing to be used on doors less than 4 sq.ft. in area, Series 200 on larger doors.
- B. Metal and Gauge: Unless specified otherwise, ASTM A 527, galvanized iron shall be used throughout. It shall be made from the best grade of mild steel sheets of the U.S. Standard Gauge as recommended in the latest edition of ASHRAE Guide and SMACNA manual.
- C. Rectangular Duct Fabrication: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards". Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

1. Fabricate dishwasher hood exhaust ducts with 18-gage stainless steel. Weld all seams and joints. Grind smooth all welds.
  2. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:  
  
Supply Ducts: 2 inches water gage.  
Return Ducts: 2 inches water gage, negative pressure.  
Exhaust Ducts: 2 inches water gage, negative pressure.
  3. Crossbreaking or Cross Beading: Crossbreak of bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. Of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard", Figure 1-4, unless they are lines that are externally insulated.
- D.** Rectangular Duct Fittings: Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Duct Construction Standard" 1985 Edition.
- E.** Round Duct Fabrication: General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet. Round Ducts: Fabricate round supply ducts with spiral lockseam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards", Table 3-2 for galvanized steel gages.
- F.** Round Supply and Exhaust Fittings Fabrication: 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards", 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance. Elbows: Fabricate in die-formed, gore, pleated, or mitered construction. Fabricate the bend radius of the die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
    - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards", Table 3-1.



of Tuttle and Bailey Type D, Elgen Manufacturing Corp., Vane Runners, or equal. Shop fabricated duct vanes shall conform to details of the Sheet Metal and Air Conditioning Contractor's Manual.

- I.** Flexible Connections: Provide sound isolating flexible connections on the inlet and outlet of each fan and unit to which duct connections are made. Flexible connections in ordinary ventilating and air conditioning systems shall be made from ventfab, fire, water and weather resistant fabric. Connections in heating installations, and for those exposed to the weather shall be made from Ventglass, neoprene coated glass fabric.
- J.** Dampers: Provide opposed blade type volume dampers where shown on drawings or otherwise necessary for proper balancing. Dampers to have felt or Neoprene edges, gasketed around inside of frame for tight fit. Dampers in ducts shall be a length equal to 1-1/2 times the duct dimensions they are to close against.
- K.** Spin-In Fittings: Provide galvanized iron spin-in fittings on all low pressure round duct connections to rectangular low pressure main duct, or where shown on the drawings, or otherwise necessary for proper balancing.
- L.** Duct Hardware for Surface Mounted Manual Dampers: Equip dampers with a length of 12" or less with Ventlok No. 620, 1/4" dial regulators, with shaft lengths of 12" to 20", Ventlok No. 635, 3/8" dial regulators and No. 607 or No. 6411 3/8 or 1/2" size with No. 607 end bearings.
- M.** Fire Dampers: Provide all fire dampers as required by building codes, complete with spring catches and constructed in accordance with NFPA Bulletin No. 90A. Fusible links shall be set for operation at 165 degrees F. Furnish complete shop drawings of all fire dampers for approval. Provide access doors, inducts, walls or ceilings as required to service all fire dampers. Fire dampers to be shutter-type mounted out of the air stream, Air Balance, Inc. Model 119A where ducts pass through masonry construction, Type "B" through metal stud or floor construction. Dampers to be tested and approved by an agency acceptable to the State Industrial Commission.
- N.** Flues and Combustion Air Intakes: Provide Type 1, PVC, Schedule 40 for use in venting systems associated with Category IV appliances in accordance with ANSIZ21.47. Provide RTV sealant at flue/intake pipe connection to furnace. Provide all required tees, caps, increasers, elbows, flashings and collars to provide complete system.
- O.** Louvers: Provide where shown on the drawings, 4" thick storm louvers with .100" wall thickness aluminum frames and .081" wall thickness aluminum fixed drainable blade louvers spaced on 3" centers and sloped at a 37-1/2 degree angle. Louvers shall have offset in blade for moisture elimination. Each louver shall be provided with a 1/4" mesh galvanized bird screen on the

inside of the louver. Finish shall be Kynar. Coordinate with Architect prior to ordering. Units shall be equal to Ruskin #ELF375DX for intake and exhaust louvers, or approved equal.

- P. Vehicle Exhaust Duct: Provide G-90 galvanized sheet metal, ASTM-A525 and -A527, in accordance with SMACNA Class 11 product conveying. It must meet or exceed criteria for construction and performance for Round Industrial Duct Construction Standards, SMACNA. Ducts 7" diameter and under shall be 24-gauge minimum and 8" diameter and above shall be 20-gauge minimum. Ducts shall be round spiral pipe constructed in accordance with an 8" w.g. (positive and negative) minimum operating pressure. Fittings shall be round and have a wall thickness 2 gauges heavier than the downstream section of duct. Converging duct branch fittings shall be 45-degree fittings. All seams, fittings and elbows shall be continuous stitch welded and internally sealed where necessary to insure air tightness.

## 2.2 DUCT LINER – INSULATION

- A. Approved Manufacturers: Owens Corning, Johns Manville, Knauf, Certainteed, or approved equal.
- B. The following ducts shall be insulated (lined) as specified below:
  - 1. All low pressure rectangular return ducts on entire runs.
  - 2. Exhaust air ducts where indicated on the drawings.
- C. Duct Liner:
  - 1. Square and Rectangular Ducts: ½" thick fiberglass, bonded with a thermosetting resin and laced with a black mat, 2 lb. per cu.ft. density with "K" value at 75 degree maximum of 0.24.

## 2.3 ROUND FLEXIBLE DUCTWORK

- A. Approved Manufacturers: Thermaflex Co., Hart & Cooley, Wiremold Co., Cleva-Flex Co., Flexmaster, Owens Corning, Omniair, or approved equal.
- B. Low Pressure Flexible Duct System: Genflex Model SFR-30A insulated factory fabricated assembly consisting of a zinc-coated spring steel helix, wrapped with a nominal 1" thick 1 lb./cu.ft. density fiberglass insulation, with the assembly sheathed in a vapor barrier jacket. The inner liner shall be of continuous non-perforated aluminum copolymer forming a positive inner air seal such that if the outer vapor barrier is punctured no air will be lost. The composite assembly, including insulation and vapor barrier shall meet the Class I requirements of NFPA Bulletin No. 90A, and be labeled by Underwriter's Laboratories, Inc., with a flame spread rated of 25 or less, and a smoke developed rating of 50 or under.

- C. Include coupling as an integral part of one end, factory installed for quick connection to an air outlet device. Additional tap-ins, straps, tape and/or connectors as required.

#### 2.4 REGISTERS, GRILLES AND DIFFUSERS

- A. Approved Manufacturers: Titus, Kruger, Price, or approved equal.
- B. Capacity: All registers, grilles and diffusers shall be as scheduled on the drawings.
- C. Steel outlets to be supplied with off white enamel finish unless specified otherwise, aluminum outlets shall remain unpainted.
- D. All steel grilles, registers, diffusers, etc., to be installed on white ceilings shall be finished with white baked enamel finish.
- E. All duct interiors visible through registers, grilles, diffusers, etc., shall be painted flat black.
- F. Suspended Grid Ceilings: Diffusers in suspended grid ceiling areas shall be same as above except steel mounting panel for integration with grid ceiling, finish to be white enamel. Volume damper to be included for each diffuser.
- G. Dampers: Provide dampers in diffusers and registers where called for in the schedule on the drawings. Dampers shall be volume control damper of the multi-blade type. The damper operator shall be equipped with a spring type lock nut which may be adjusted to the required friction to prevent readjustment of unauthorized persons and to prevent closing of the damper when in the partially open position because of static pressure.
- H. Mounting: This Sub-Contractor shall coordinate the location of the diffuser, ceiling lights, and any other ceiling outlets to avoid possible conflicts.

### **PART 3 - EXECUTION**

#### 3.1 SHEET METAL WORK AND ACCESSORIES

- A. Install all sheet metal duct systems, connections, splitters, dampers, duct turns, housings, hinged sheet metal doors and necessary removable access doors for the complete supply, return and exhaust systems in accordance with SMACNA manual. Access doors shall be provided in ductwork wherever required for observation and maintenance of all motorized dampers.
- B. Duct Workmanship: All ductwork and accessories shall be constructed and erected in a workmanlike manner. Ducts shall be straight and smooth on the

inside with neatly finished joints, air-tight, and shall be free from vibration under all conditions of operation. The internal ends of slip joints shall be made in the direction of air flow. The ducts shall be securely attached to the building construction in an approved manner. Changes in dimensions and shape of ducts shall be gradual. All duct sizes fall within the limiting dimensions indicated on the drawings unless otherwise approved. Curved elbows shall have a center line radius equal to 1-1/2 times the width of the duct.

- C. **Ductwork Sealing:** All low pressure ductwork systems, including supply, return, exhaust and outside air duct systems, to inlet or outlet shall be installed and sealed as required in accordance with SMACNA manual to withstand 2" w.c. pressure on entire ductwork systems. All medium pressure ductwork shall be installed and sealed as required in accordance with SMACNA manual to withstand 6" w.c. from fan apparatus to VAV terminal units. Taping of joints will not be allowed.
- D. **Flexible Connections:** Install sound isolating flexible connections on the inlet and outlet of each fan and unit to which duct connectors are made. At least one inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.
- E. **Joints and openings in ducts and around equipment with excessive leakage shall be caulked air tight.** All ducts run on roof shall have all joints caulked with G.E. Silicone sealer.
- F. **Flanges:** Wherever exposed ducts pass through walls, floors or ceiling, a 2" flanged sheet metal collar fitting close around ducts shall be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Lock collar to duct.
- G. **Dampers:** Install all dampers securely. Splitter dampers shall be of heavy construction, adequately braced and properly mounted to prevent causing any noise in the ducts.
- H. **Fire Dampers:** Install all fire dampers as required by building codes. Stencil and letter "F.D." on all access doors to fire dampers after final coat of paint has been applied to the doors.
- I. **Flues and Intakes:** Install in strict accordance with manufacturer's instructions.

### 3.2 ROUND FLEXIBLE DUCTWORK

- A. Flexible ducts shall be installed in a fully extended condition free of sags and kinks, using only the minimum length required to make the connection. Maximum length of any duct run shall be 6'-0".
- B. Where horizontal support is required, flexible duct shall be suspended on 36-inch centers with a minimum 3/4-inch wide flat banding material. All joints and connections shall be made with 1/2" wide positive.
- C. Where "lift-out" ceilings occur, flex ducts shall be installed with volume damper in flex duct at connection to main duct, and a distributing grid at the diffuser.
- D. Where permanent ceilings occur, omit the damper in flex duct, provide an opposed blade volume damper at the diffuser (omit the distributing grid at the diffuser).

### 3.3 DUCT LINER

- A. Duct liner (square and rectangular ducts) shall be secured to the metal with a solid coat of adhesive, black mat side to the air stream. Top and bottom sections shall overlap the sides, and all joints shall be firmly butted and ends coated with adhesive.
- B. Duct sizes as indicated on drawings are clear inside dimensions, and where duct liner is used, duct sizes shown shall be increased to allow for liner.
- C. All ducts exposed to weather shall have joints sealed absolutely weather tight with flanges and General Electric silicone sealer.

### 3.4 REGISTERS, GRILLES, DIFFUSERS

- A. Mounting: This Sub-Contractor shall coordinate the location of the diffuser, ceiling lights, and any other ceiling outlets to avoid possible conflicts.
- B. Install all units to provide a vibration free connection to the fan system.

### 3.5 EQUIPMENT

- A. Install all exhaust fans to the curb or structure as required and make necessary adjustments to eliminate vibration. Verify proper rotation direction of fan wheels.
- B. Install all equipment in accordance with manufacturer's recommendations.

### 3.6 SEAM AND JOINT SEALING

- A. General: Seal all duct seams and joints per SMACNA seal Class A as follows:

- B.** Pressure Classifications Greater Than 3 Inches Water Gage: All transverse joints, longitudinal seams, and duct penetrations.
- C.** Pressure Clarification 2 Inches Water Gage: All transverse joints and longitudinal seams.
  - 1.** Pressure Classification Less Than 2 Inches Water Gage: All transverse joints and longitudinal seals.
- D.** Seal externally insulated ducts prior to insulation installation.

### 3.7 HANGING AND SUPPORTING

- A.** Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards", Tables 4-1 through 4-3 and Figures 4-1 through 4-8.
- B.** Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- C.** Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D.** Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- E.** Install concrete insert prior to placing concrete.
- F.** Install powder actuated concrete fasteners after concrete is placed and completely cured.

### 3.8 CONNECTIONS

- A.** Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories".
- B.** Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards", Figures 2-16 through 2-18.
- C.** Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards", Figures 2-16 through 2-17.
- D.** Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards", Figure 2-19.

### 3.9 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
- B. Conduct test, in the presence of the Architect, at static pressures equal to the maximum design pressure of the system or the section being tested. If the pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure. Give 7 day's advanced notice for testing.
- C. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test sections.
- D. Maximum Allowable Leakage: As described in ASHRAE 1989 Handbook, "Fundamentals" Volume, Chapter 32, Table 6 and Figure 10. Comply with requirements for leakage classification 3 for round and flat oval ducts, leakage classification 12 for rectangular ducts in pressure classifications less than and equal to 2 inches water gage (both positive and negative pressures), and leakage classification 6 for pressure classifications greater than 2 inches water gage and less than and equal to 10 inches water gage.
- E. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.
- F. Leakage Test: Perform volumetric measurements and adjust air systems as described in ASHRAE 1987 "HVAC Systems and Application" Volume, Chapter 57 and ASHRAE 1989 "Fundamentals" Volume, Chapter 13, and Section 15990 "TESTING, ADJUSTING, AND BALANCING".

### 3.10 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Section 15990 "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

**END OF SECTION 15880**

## SECTION 15920 – TEMPERATURE CONTROL SYSTEMS

### PART 1 GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

- A. Work of this section generally includes provision of automatic control equipment and accessories related to the temperature control system.
- B. This section shall furnish labor, materials, equipment and services necessary to provide temperature control as indicated on the drawings and as specified herein.

#### 1.3 SUBMITTALS

Furnish five copies of submittals showing equipment, piping and wiring required including a sequence of operation, all of which must be approved prior to installation of any controls. Submittals shall show terminal-terminal wiring and show controls schematically on mechanical equipment. Shop drawings shall contain the following information:

- A. Schematic flow control diagram of system showing fans, heat pumps, pumps, make-up air units, dampers, valves and control devices.
- B. Label each control device with setting or adjustable range of control.
- C. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Provide details of faces of control panels, including controls, instruments, and labeling.
- E. Include written description of sequence of operation, including operation of components, valves, dampers, etc.
- F. Complete valve list showing gpm, pressure drop and size of each control valve with its locations.
- G. List of automatic dampers showing size, pressure drop and amount of

pressure handled by each damper operator.

#### 1.4 INSTALLATION

Electric Wiring – Mechanical Contractor shall install and wire all the automatic controls listed under these temperature control specifications. Wiring shall meet the standards as prescribed under the electrical section of these specifications.

#### 1.5 GENERAL REQUIREMENTS

- A. Automatic temperature control system shall be electric or electronic–components unless otherwise specified. The system shall be complete and operational in every respect, put in operation and adjusted under operating conditions.
- B. Include all control devices, valves and dampers, wire, conduit, etc. as specified and required and connected so as to perform all functions and operate to the specified sequences. Automatic control valves furnished under this section are to be installed by the mechanical contractor as directed and supervised by temperature control installer.

### PART 2 – PRODUCTS

#### 2.1 APPROVED MANUFACTURERS

Honeywell, Inc., Johnson Controls, Inc., Landis–Staefa Company, Siebe Inc., Trane Co., Carrier Corp., or approved equal.

#### 2.2 GENERAL

Provide control products in sizes and capacities indicated or required for the application, consisting of valves, dampers, thermostats, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated. All control point settings shall be adjustable with suitable range and sensitivity for proper operation.

#### 2.3 THERMOSTATS

- A. General: Provide room thermostats with locking covers, and with concealed or readily–accessible adjustment devices and dead band, as indicated.
- B. Miscellaneous Thermostats: Provide thermostats of solid–state type; UL

listed at electrical rating comparable with application. Equip thermostats which control electric heating loads directly, with Off position on dial wired to break ungrounded conductors. Provide as integral part of each thermostat, lever operated manual switch for control of fan in each unit with type of control as indicated. Label switches "fan on-off". Provide factory-fabricated unit, capable of being mounted on 2-gang switch box or mud ring, and night setback features.

C. Make-up Air Unit and Indirect Evaporative Cooler Thermostats:

1. The office HVAC system thermostats shall be provided by the equipment manufacturer and/or compatible with equipment (refer to Section 15860) and shall be equipped with the following features:
  - a. 7-day programmable
  - b. Modulating heat
  - c. 2-stage cool (where applicable)
  - d. System functions: Off-Heat-Cool-On
  - e. Fan switch: On-Auto
  - f. Specific fault indication
  - g. Setback operation with override

2.4 TEMPERATURE SENSORS

- A. Resistance Temperature Detectors: Platinum. Accuracy: Plus or minus 0.2 percent at calibration point. Wire: Twisted, shielded-pair cable.
  1. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

2.5 DAMPERS

Johnson Controls, Greenheck, Ruskin, Louvers & Dampers, or prior approved equal. No other dampers will be acceptable without prior written approval of the Engineer. Damper frames shall be 13-gauge galvanized steel channel with reinforced corner bracing. Damper blades shall not exceed 6" in width, fabricated of two pieces of 22-gauge galvanized corrugated sheet steel soot welded together. Blades are to be suitable for high velocity performance. Damper bearings shall be nylon. Bushings that turn in the bearings are to be oil impregnated sintered metal. All edges of the blades and top, bottom and sides of the frame shall be provided with replaceable butyl rubber seals to provide a maximum 1% leakage at a wide open face velocity of 1500 fpm and 6" static pressure. The damper linkage shall provide a linear flow of equal percentage characteristic as required. Damper schedules shall be submitted to the Architect for approval and shall show exact standard damper sizes and blank off plate sizes if required as well as leakage and flow characteristic charts. Provide electric actuator.

2.6 DAMPER MOTORS

- A. Size each motor to operate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified.
- B. Provide permanent split-capacitor or shaded pole type motors with gear trains completely oil-immersed and sealed. Equip spring-return motors, where indicated on drawings or in operational sequence, with integral spiral-spring mechanism. Furnish entire spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- C. Equip motors for outdoor locations and for outside air intakes with "O ring" gaskets designed to make motors completely weatherproof, and equip with internal heaters to permit normal operation at -40°F.
- D. Furnish non-spring return motors for dampers larger than 25 sq.ft., and for valves larger than 2-1/2", sized for running torque rating of 150 inch-pounds, and breakaway torque rating of 300 inch-pounds. Size spring-return motors for running torque rating of 150 inch-pounds, and breakaway torque rating of 150 inch-pounds.

## 2.7 TIME CLOCKS

- A. Provide a four-pole (2 N.O., 2 N.C.) single-throw, seven-day electric time clock with reverse spring power for ten (10) hours of operation after a power failure. Unit shall be capable of different adjustable daily settings, seven days a week. Unit shall be wired with a bypass power supply and a contactor (N.O.) controlled by an override switch, located as on the drawings so setback may be overridden.
- B. Time clock to be mounted in temperature control panel to provide day-night or occupied-unoccupied control cycles as follows:
  - 1. Day or Occupied Cycle: All equipment shall operate as described in "Sequence of Operation".
  - 2. Night or Unoccupied Cycle: All equipment shall operate as described in "Sequence of Operation."
- C. Time-clock shall be capable of scheduling lead-lag operation of primary-standby pump system.

## 2.8 COMBINATION CO/NO2 MONITOR AND ALARM

- A. Vulcain Model VA301M stand-alone dual gas monitor with VA301MQ2CO-NO2-DIS CO sensor, S301MN02 remote NO2 sensor and

VA201TA50 transformer. Alternate manufacturers shall submit for approval prior to bid.

1. Locate the monitor/alarm in the Office.

## PART 3 – EXECUTION

### 3.1 SEQUENCE OF OPERATION

Refer to Section 15950 for Sequence of Operation for the Temperature Control System.

### 3.2 INSTALLATION

- A. Electric Wiring: Install and wire all the automatic controls listed under these temperature control specifications. Conform wiring to standards of Division 16.
- B. Sensors: All temperature control bulbs and thermometers sensing air temperature shall be properly located to best prevent freeze-up and to compensate for possible stratification of air in the system. Use averaging bulbs for outside air, return air plenums and where specified.
- C. Thermostats: Coordinate locations of room thermostats with Architect and with the location of light switches, communication panels, etc.

### 3.3 ADJUSTING AND CLEANING

- A. Start-up: Start-up, test and adjust pneumatic control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Place in complete operating condition subject to the approval of the Engineer.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors, and similar equipment provided as work of this section.
- D. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

### 3.4 POST-INSTALLATION INSTRUCTIONS

Upon completion of the work, instruct the operating personnel in proper operation of this control system. Following completion and acceptance of job,

control drawings, and sequence of operation instructions shall be delivered to the Owner in bound form.

### 3.5 SERVICE AND GUARANTEE

The control system specified herein shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from the date of acceptance by the Engineer, any of the equipment herein described is proved to be defective in workmanship or material, it will be adjusted, repaired or replaced free of charge by the automatic control contractor.

END OF SECTION 15920

## SECTION 15950 – SEQUENCE OF OPERATIONS

### PART 1 – SEQUENCE OF OPERATION

#### 1.1 Indirect Evaporate Cooler (IEC-1 and IEC-2):

- A. Cooling Mode: The supply fan runs continuously. The room thermostat stages the cooling functions to maintain room temperature at set point.
- B. Mechanical Cooling: Is initiated when Outside air temperature is greater than 65° F. As room temperature rises above set point, the discharge isolation damper modulates to the 100% open position. Cooler units are then sequenced on to satisfy the cooling demand. As units are energized, the respective isolation dampers are powered open. A damper actuator position switch will lockout the respective unit until the open position is proved.
- C. IEC-1 and IEC-2 shall be disabled whenever MAU-1 is in operation; i.e. the heating and cooling systems shall not be allowed to operate simultaneously.

#### 1.2 Make-up Air Unit (MAU-1): Provide self contained unit with remote mounted control panel to provide independent control of heating (settings adjustable). Make-up air unit shall be interlocked with IEC-1 and IEC-2 as follows:

- A. MAU-1 Control Occupied Mode: The Supply fan runs continuously. The room thermostat and digital controller cycle on the heating section to maintain space temperature at set point.
- B. Normal Operation: Unit intake air damper shall be open 100%. Fan shall run continuously; space thermostat shall modulate the unit gas valve, through the factory supplied control panel, to maintain space temperature.
- C. IEC-1 and IEC-2 shall be disabled whenever MAU-1 is in operation; i.e. the heating and cooling systems shall not be allowed to operate simultaneously.

#### 1.3 Exhaust Fans: (EF)

- A. EF-1 through EF-8 and EF-10: The exhaust fan is controlled from a manual wall switch. The fan shall be energized whenever the switch is in the "ON" position.
  - 1. EF-3 through EF-6 and EF-8: Interlock exhaust fan with motorized intake air damper as shown on the Drawings. The motorized damper shall have an end switch. The motorized damper shall

prove to be in the open position before allowing the exhaust fan to energize.

- B. EF- 9 Control: The vehicle fume exhaust system shall be energized via a starter and manual control switch provided by the fan manufacturer. Mount controls on wall.
- C. EF-11 Control: The exhaust fan shall be energized by a line-voltage reverse-acting thermostat. The exhaust fan shall energize upon a rise in space temperature above 85 °F (adj.).

1.4 Gas-fired Unit Heater:

- A. A wall mounted thermostat cycles on the fan and stages the heat to maintain temperature at set point whenever the thermostat switch is in the "HEAT" mode. The space temperature set point shall be 50 °F (adj.).

1.5 Gas-fired Infrared Radiant Heater:

- A. A wall mounted thermostat cycles on the respective unit to maintain temperature at set point whenever the thermostat switch is in the "HEAT" mode. The space temperature set point shall be 60 °F (adj.).

**PART 2 – NOT USED**

**PART 3 – NOT USED**

**END OF SECTION 15950**

## SECTION 15990 – TESTING, ADJUSTING AND BALANCING

### PART 1 – GENERAL

#### 1.1 RELATED

"General Requirements", Division 1 and Mechanical Basic Materials and Methods Spec Section 15050 of the Project Manual pertain to and are hereby made part of the work of the Spec Section.

#### 1.2 DESCRIPTION OF WORK

A. This section covers testing, adjusting and balancing (TAB) of Division 15 environmental systems, including (but not limited to) heating/cooling units, air distribution systems and dynamic balance testing of the equipment and apparatus connected thereto.

B. Related Work Specified Elsewhere:

Submittals: Section 01300

Project Closeout: Section 01700

#### 1.3 REFERENCES

A. Comply with procedural standards for Testing, adjusting and balancing of environmental systems as outlined in the latest edition of SMACNA, NEBB and/or AABC procedural manuals.

B. Applicable sections and paragraphs as published in ASHRAE 1991 Applications Handbook, Chapter 34, Testing, Adjusting and Balancing.

#### 1.4 QUALIFICATIONS

A. Qualified firms desiring to furnish services for this project shall submit for written approval, during bid time, a brochure listing the qualifications of personnel in the organization, instruments available to be used, an outline of system balancing procedures that is intended to be followed, and a list of projects successfully balanced within the last two years. Information regarding additional qualifications listed below must be in the office of the Engineer at least fourteen calendar days prior to the date set for receiving bids.

B. TAB firm shall have at least one NEBB or AABC certified TAB supervisor, or this work shall be supervised by a registered Professional Engineer (PE). Certify that this person has been associated with the TAB firm for at least two years.

- C. TAB firm shall have a minimum of three permanent employees who have been actively engaged in balancing work for a minimum of three (3) years. Provide names and experience resumes.
1. Pre-qualified firms are as follows:  
Griffith Engineering  
Tab, Inc.  
Finn and Associates  
Complete Mechanical Balancing  
Checkpoint Balance
  2. TAB firm shall own or rent and have available for this project all necessary balancing instruments as required to maintain NEBB certification. Instrument calibration shall have been checked and verified as per NEBB requirements. Provide instrument list with calibration date for each instrument listed.

#### 1.5 RETAINAGE

Contract payment retainage may be withheld against the General Contractor until the final completion of this section of work has been demonstrated by the submission of the TAB report and an evaluation of its contents has been made by the Owner or his representative.

#### 1.6 QUALITY ASSURANCE

- A. Testing, adjusting and balancing shall be done by a NEBB or AABC certified firm, or by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with the mechanical contractor performing work under Division 15; the firm derives its income solely from testing, adjusting and balancing and/or commissioning mechanical systems, and the work is performed in a professional manner per Item B.
- B. The balancing work, including air portions, shall be performed by the same firm having total professional responsibility for the final testing, adjusting and balancing of the entire systems.

All balancing shall be performed under the direction of a registered Professional Engineer who has had at least five years of balancing experience in the state in which the work is being done, or under direction of an NEBB or AABC certified TAB Supervisor per Item 1.03-E.

#### 1.7 SUBMITTALS

- A. Refer to Section 01300 General Requirements.
- B. Within 30 days after contract award, submit the names(s) of the professional

engineer and/or the NEBB or AABC certified supervisor who will be supervising this work.

- C. Submit proposed TAB forms and report formats to Owner or his representative for approval at least 120 days prior to commencing field work.

## **PART 2 – PRODUCTS**

### **2.1 EQUIPMENT**

- A. Provide all necessary tools, scaffolding, and ladders.
- B. Provide all necessary instruments. Calibration and maintenance of instruments shall be in accordance with SMACNA, NEBB, AABC and/or manufacturer's standards and recommendations.
- C. Provide all sheaves, dampers, and belts for replacement required to completely balance systems.
- D. Calibration histories for each instrument shall be available for examination.

## **PART 3 – EXECUTION**

### **3.1 SCHEDULING OF WORK**

- A. Coordinate scheduling of work with the General Contractor and appropriate subcontractors.

Schedule TAB work to coincide with testing and verification of control systems where practical.

- B. Provide written notification (within 24 hours) to General Contractor, Engineer and Owner or his representative of any component and/or system deficiencies.

### **3.2 STATUS OF SYSTEMS**

- A. Air testing and balancing shall not begin until the system to be tested has been cleaned and flushed, and is in full working order.
- B. Put heating, ventilating and air conditioning systems and equipment into full operation and continue operation of same during each working day of testing and balancing. Preliminary TAB requirements shall be ascertained prior to the commencement of work through a review of available plans and specifications for the project. In addition, visual observations at the site during construction shall have been made to determine the location of required balancing devices, that they are being installed properly, and access is provided.

### 3.3 GENERAL

At the completion of the Mechanical installation, including all piping, ducting, control, and power wiring components, the various systems shall be placed in operation and the TAB Contractors crew shall proceed with the final "Balance" of the various systems.

### 3.4 SUPPLY SYSTEMS

- A. General: Before any adjustments are made, the system is to be checked for items such as dirty filters, filter leakage, equipment vibrations, damper operation, etc. Zones, etc., are to be adjusted to deliver design air and hydronic quantities within plus or minus 10%. Individual air outlets when one of three or more are serving one space may have a tolerance of 15% of average.
- B. The Balancing Contractor shall be responsible for all drive changes and overload heater changes required to put the system into proper balance. Total air volume for each system shall be adjusted by drive speed changes and not outlet or duct dampers.
- C. All fan systems including unit heaters, exhaust fans, make-up air units, etc. : Level and proportion air volume at all registers, diffusers, louvers, filters, hoods, terminal boxes, coils, etc. Adjust to design capacities.
- D. Fan Systems: Are to be checked for motorized mixing damper leakage. Air quantities are to be adjusted with all mixing dampers set for cooling. When this has been done, all mixing dampers are to be set for heating and the total flow to each zone again determined and adjusted. Finally, the zone mixing dampers are to be placed in modulating positions and the total air flow determined. If it is significantly higher than for either heating or cooling, motor current is to be measured and fan speed adjusted as required to prevent motor overload.

### 3.5 EXHAUST AND RECIRCULATING AIR SYSTEMS

To be adjusted to same tolerance as SUPPLY SYSTEMS, then each space is to be checked to see that it is positive, neutral, or negative as indicated by quantities of supply and exhaust shown on plans. Any discrepancies are to be investigated and corrected and the proper pressure relationship established. Finally, building pressure is to be checked at outside doors, and exhaust fan speeds revised as required to leave building neutral or under slight positive pressure.

### 3.6 SYSTEM PERFORMANCE

To be checked when outside weather is at or near design conditions if practical. (Heating and/or Cooling) thermometers are to be placed in the areas served by each

fan system temperature readings taken at half hour intervals and further adjustments or corrections made as required to obtain uniform temperatures. All occupied spaces are to be checked for drafts and noises caused by the ventilating systems, and any unsatisfactory conditions corrected.

### 3.7 WATER CIRCULATING SYSTEMS (PLUMBING)

- A. Evaporative Cooling (IEC): Adjust fittings to provide specified water, design capacity, with manual valves open and pressure reducing valve adjusted.

### 3.8 MISCELLANEOUS

When final adjustments have been made, temperature readings are to be taken at half hour intervals for a three hour period minimum, all manual damper positions are to be marked, and access covers replaced. The adjusting crew is to measure and set any special conditions such as minimum outside air quantities; check and adjust outside and return air quantities; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "Report" below.

### 3.9 REPORT

A complete report of the system and its operation is to be made to the Engineer, and is to include the following:

- A. A set of black and white or blue line prints with all air openings marked to correspond with data sheets, and with thermometer locations clearly marked.
- B. Data sheets giving log of room temperature.
- C. Data sheets showing amount of air handled at each opening.
- D. Equipment data sheets giving make, size, etc. of fans, motors and drives. Include supply fans, exhaust and recirculating fans, etc.
- E. Cooling equipment data including air wet bulb and dry bulb temperatures entering and leaving cooling media (maximum air temperature drop) together with corresponding air flow and air pressure drop.
- F. Heating equipment operating data including air temperatures entering and leaving heating furnace (maximum air temperatures rise) together with corresponding air flow and air pressure drop.
- G. Operating data including fan RPM, inlet and outlet pressures drop across filters, measured motor current and voltage, and total fan static pressure. Both design and test conditions shall be tabulated. Where practical a pilot tube traverse of the duct will be taken indicating proper air quantities are being delivered. Where pitot tube traverse is not practical, other approved

testing method shall be used.

- H. Equipment and operating data as required to show performance of fans, compressors, and other items of equipment as specified.
- I. A report outlining any abnormal or notable conditions not covered in the above outline.

**END OF SECTION 15990**

## **SECTION 260500 COMMON WORK RESULTS FOR ELECTRICAL**

### **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. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

#### **1.3 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### **1.4 SUBMITTALS**

- A. Product Data: For sleeve seals.

#### **1.5 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## **PART 2 - PRODUCTS**

### **2.1 SLEEVES FOR RACEWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

### **2.2 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.3 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## **PART 3 - EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### **3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### **3.3 SLEEVE-SEAL INSTALLATION**

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.4 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

**END OF SECTION 260500**

**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.
  - 3. Sleeves and sleeve seals for cables.
- 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.

**1.3 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

## **1.5 QUALITY ASSURANCE**

- A. 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.
  - 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. 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.
- C. Comply with NFPA 70.

## **1.6 COORDINATION**

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## **PART 2 - PRODUCTS**

### **2.1 CONDUCTORS AND CABLES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Aluminum and Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable (Type MC), mineral-insulated, metal-sheathed cable, Type MI, and nonmetallic-sheathed cable, Type NM, with ground wire.

## **2.2 CONNECTORS AND SPLICES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## **2.3 SLEEVES FOR CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## **2.4 SLEEVE SEALS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **PART 3 - EXECUTION**

### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type THHN-THWN, single conductors in raceway or Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### **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. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

### **3.6 SLEEVE-SEAL INSTALLATION**

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **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.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test 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.
- D. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION 260519**

# 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 Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

#### 1.4 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.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. 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 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 wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 2 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches 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.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  1. Bury at least 24 inches below grade.
- 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 1 inch minimum from wall, 6 inches above finished floor unless otherwise indicated.
- 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 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.
- 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. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater: 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.

## 3.3 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. 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.
- C. 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.
- D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

**END OF SECTION 260526**

# 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.

#### 1.3 DEFINITIONS

- A. **EMT: Electrical metallic tubing.**
- B. IMC: Intermediate metal conduit.
- C. 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 to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

2. Nonmetallic slotted support systems.
- 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.
- C. Welding certificates.

## **1.6 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## **1.7 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."

## **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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.
  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.
  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- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. Fabco Plastics Wholesale Limited.
    - d. Seasafe, Inc.
  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. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.
  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. One-time expansion anchors are not allowed.

## **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 NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch 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, IMC, 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.

- 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  7. To Light Steel: Sheet metal screws.
  8. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Division 05 Section "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. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. 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.
- B. Touchup: Comply with requirements in Division 09 painting Sections 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.

**END OF SECTION 260529**

**SECTION 260533**  
**RACEWAY 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. This Section includes raceways, fittings, boxes, and enclosures for electrical wiring.

**1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

**1.4 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, and hinged-cover enclosures.

**1.5 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.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUIT AND TUBING**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. Electri-Flex Co.
  - 6. Manhattan/CDT/Cole-Flex.
  - 7. Maverick Tube Corporation.
  - 8. O-Z Gedney; a unit of General Signal.
  - 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit and IMC.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  - 2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
  - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. Arnco Corporation.
  - 4. CANTEX Inc.
  - 5. CertainTeed Corp.; Pipe & Plastics Group.
  - 6. Condux International, Inc.
  - 7. ElecSYS, Inc.
  - 8. Electri-Flex Co.
  - 9. Lamson & Sessions; Carlon Electrical Products.
  - 10. Manhattan/CDT/Cole-Flex.
  - 11. RACO; a Hubbell Company.
  - 12. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

## 2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include 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 as indicated.
- E. Finish: Manufacturer's standard enamel finish.

## **2.4 SURFACE RACEWAYS**

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.

## **2.5 BOXES AND ENCLOSURES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Robroy Industries, Inc.; Enclosure Division.
  - 9. Scott Fetzer Co.; Adalet Division.
  - 10. Spring City Electrical Manufacturing Company.
  - 11. Thomas & Betts Corporation.
  - 12. Walker Systems, Inc.; Wiremold Company (The).
  - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

## **2.6 SLEEVES FOR RACEWAYS**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## **2.7 SLEEVE SEALS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. 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.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

- I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- J. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- K. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit forequipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 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.
- L. 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.

### 3.2 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
  - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
  - 2. Install backfill as specified in Division 31 Section "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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
  - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
  - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
  - 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

### **3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

### **3.4 SLEEVE-SEAL INSTALLATION**

- A. Install to seal underground, exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.5 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### **3.6 PROTECTION**

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 260533**

**SECTION 260553**  
**IDENTIFICATION 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. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

**1.3 SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.

**1.4 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

## 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- D. Write-On Tags: Polyester tag, **[0.010 inch]** **[0.015 inch]** **<Insert dimension>** thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.4 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## **2.5 FLOOR MARKING TAPE**

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## **2.6 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE.

## **2.7 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

## **2.8 INSTRUCTION SIGNS**

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- 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. Overlay shall provide a weatherproof and UV-resistant seal for label.

## **2.9 EQUIPMENT IDENTIFICATION LABELS**

- A. Engraved Three-Layer Laminated Plastic: Black letters on white background. Minimum letter height shall be 3/8 inch. Fastened to equipment with two self-tapping stainless steel screws.

## **2.10 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

## **2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  1. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
    - a. Color shall be factory applied.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f. Enclosed switches.
- g. Enclosed circuit breakers.
- h. Enclosed controllers.
- i. Variable-speed controllers.
- j. Push-button stations.
- k. Contactors.
- l. Remote-controlled switches, dimmer modules, and control devices.
- m. Monitoring and control equipment.

**END OF SECTION 260553**

## **SECTION 260923**

### **LIGHTING CONTROL DEVICES**

#### **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 lighting control devices:
  - 1. Time switches.
  - 2. Indoor photoelectric switches.
  - 3. Indoor occupancy sensors.
  - 4. Lighting contactors.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

##### **1.3 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

## **1.5 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.

## **1.6 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 TIME SWITCHES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Area Lighting Research, Inc.; Tyco Electronics.
  - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
  - 3. Intermatic, Inc.
  - 4. Leviton Mfg. Company Inc.
  - 5. Lightolier Controls; a Genlyte Company.
  - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 7. Paragon Electric Co.; Invensys Climate Controls.
  - 8. Square D; Schneider Electric.
  - 9. TORK.
  - 10. Touch-Plate, Inc.
  - 11. Watt Stopper (The).
- B. Digital Time Switches: Type complying with UL 917.
  - 1. Time-out settings ranging from 5 minutes to 8 hours.
  - 2. Optional visual warning: flashes lights at 5 minutes and 1 minute prior to time-out.
  - 3. Optional audible warning: beeps every 5 seconds at 1 minute prior to time-out.
  - 4. No minimum load requirement.
  - 5. Compatible with all electronic ballasts and motor loads.

### **2.2 INDOOR PHOTOELECTRIC SWITCHES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Allen-Bradley/Rockwell Automation.
  - 2. Area Lighting Research, Inc.; Tyco Electronics.
  - 3. Eaton Electrical Inc; Cutler-Hammer Products.
  - 4. Grasslin Controls Corporation; a GE Industrial Systems Company.
  - 5. Intermatic, Inc.

6. Lithonia Lighting; Acuity Lighting Group, Inc.
  7. MicroLite Lighting Control Systems.
  8. Novitas, Inc.
  9. Paragon Electric Co.; Invensys Climate Controls.
  10. Square D; Schneider Electric.
  11. TORK.
  12. Touch-Plate, Inc.
  13. Watt Stopper (The).
- B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
  4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

### 2.3 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Hubbell Lighting.
  2. Leviton Mfg. Company Inc.
  3. Lithonia Lighting; Acuity Lighting Group, Inc.
  4. Novitas, Inc.
  5. RAB Lighting, Inc.
  6. Sensor Switch, Inc.
  7. TORK.
  8. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.

- b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 6. Bypass Switch: Override the on function in case of sensor failure.
  - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
- 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.4 LIGHTING CONTACTORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
- 1. Allen-Bradley/Rockwell Automation.
  - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 4. GE Industrial Systems; Total Lighting Control.
  - 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
  - 6. Hubbell Lighting.
  - 7. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 8. MicroLite Lighting Control Systems.
  - 9. Square D; Schneider Electric.
  - 10. TORK.
  - 11. Touch-Plate, Inc.
  - 12. Watt Stopper (The).
- B. Description: Electrically or magnetically operated and mechanically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
- 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## **2.5 CONDUCTORS AND CABLES**

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [18] [22] [24] AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [14] [16] [18] AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## **PART 3 - EXECUTION**

### **3.1 SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### **3.2 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### **3.3 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

### **3.5 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 260923**

## **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.

##### **1.3 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.
- 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.
- C. Source quality-control test reports.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

##### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. 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.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

## **1.5 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.

## **1.6 COORDINATION**

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 2. General Electric Company.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; Schneider Electric.

### **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: Copper.

### **2.3 DISTRIBUTION TRANSFORMERS**

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

- D. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- G. Wall Brackets: Manufacturer's standard brackets.

## **2.4 IDENTIFICATION DEVICES**

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## **2.5 SOURCE QUALITY CONTROL**

- A. Test and inspect transformers according to IEEE C57.12.91.

# **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 Division 26 Section "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. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

### **3.3 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Provide minimum of 2' and maximum of 3' flexible conduit for transformer connections.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. 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. 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.

**END OF SECTION 16461**

# **SECTION 262416**

## **PANEL BOARDS**

### **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. Distribution panel boards.
  - 2. Lighting and appliance branch-circuit panel boards.

#### **1.3 DEFINITIONS**

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### **1.4 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.
- 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 panel boards and overcurrent protective devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 6. Include wiring diagrams for power, signal, and control wiring.
  - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panel boards.
- C. 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.
- D. Panelboard Schedules: For installation in panel boards. Submit final versions after load balancing.
- E. Operation and Maintenance Data: For panel boards 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.

## **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain panel boards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panel boards including clearances between panel boards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panel boards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panel boards for installation according to NECA 407.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Limitations:
1. Do not deliver or install panel boards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panel boards 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 22 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
  
- 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. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Architect's, Construction Manager's, and Owner's written permission.
  - 3. Comply with NFPA 70E.

## **1.8 COORDINATION**

- A. Coordinate layout and installation of panel boards 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.

## **1.9 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: One year from date of Substantial Completion.

## **1.10 EXTRA MATERIALS**

- 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 spares for each type of panelboard cabinet lock.
  - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two 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.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR PANEL BOARDS**

- A. Enclosures: Surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. Skirt for Surface-Mounted Panel boards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 5. Finishes:
    - a. Panels and Trim: 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: Same finish as panels and trim.
  - 6. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. 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.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Compression type.
  - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
  - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

### **2.2 DISTRIBUTION PANEL BOARDS**

- 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.
- B. Panel boards: 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 high, provide two latches, keyed alike.
- D. Mains: Lugs only.
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

### **2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANEL BOARDS**

- 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.
- B. Panel boards: 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. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

### **2.4 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. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with 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  $I^2t$  response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Compression 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 relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

## 2.5 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 panel boards according to NECA 407.
- B. Examine panel boards before installation. Reject panel boards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panel boards 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 panel boards and accessories according to NECA 407.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.
- I. Vacuum out interiors of all panel boards clean of debris.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. 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 Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panel boards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- 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 and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 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 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. Panel boards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panel boards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.5 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
- C. Load Balancing: After Substantial Completion, but not more than 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.

### **3.6 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 262416**

## **SECTION 262726**

### **WIRING DEVICES**

#### **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. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Snap switches.
  - 3. Wall-switch sensors.
  - 4. Cord and plug sets.

##### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

## **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. 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.
- C. Comply with NFPA 70.

## **1.6 COORDINATION**

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

### **2.2 STRAIGHT BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).

### **2.3 GFCI RECEPTACLES**

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; GF20.
    - b. Pass & Seymour; 2084.

## 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

## 2.6 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Cooper.
    - b. Hubbell.
    - c. Leviton.
    - d. Pass & Seymour.
    - e. Sensor Switch.
    - f. Watt Stopper (The).

2. Description: Dual-technology type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 200 sq. ft..

## 2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
  - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover.

## 2.8 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:

- a. Cut back and pigtail, or replace all damaged conductors.
- b. Straighten conductors that remain and remove corrosion and foreign matter.
- c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

### 3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

**END OF SECTION 262726**

# SECTION 262816

## ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 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:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Shunt trip switches.
  - 4. Molded-case circuit breakers (MCCBs).
  - 5. Molded-case switches.
  - 6. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. 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.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers 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 enclosed switches and circuit breakers.
  2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

## **1.5 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 enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, 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 NFPA 70.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.

- B. 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. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Architect's, Construction Manager's, and Owner's written permission.
  - 4. Comply with NFPA 70E.

## **1.7 COORDINATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## **1.8 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## **PART 2 - PRODUCTS**

### **2.1 FUSIBLE SWITCHES**

- 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.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Lugs: Compression type, suitable for number, size, and conductor material.

4. Service-Rated Switches: Labeled for use as service equipment.

## 2.2 NONFUSIBLE SWITCHES

- 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.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Lugs: Compression type, suitable for number, size, and conductor material.

## 2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussmann, Inc.
  2. Ferraz Shawmut, Inc.
  3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

- E. Accessories:
1. Oiltight key switch for key-to-test function.
  2. Oiltight red ON pilot light.
  3. Isolated neutral lug; 200 percent rating.
  4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  5. Form C alarm contacts that change state when switch is tripped.
  6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
  7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

- 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.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
  2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
  3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

## 2.5 MOLDED-CASE SWITCHES

- 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.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

## **2.6 ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- E. Comply with NECA 1.

### **3.3 IDENTIFICATION**

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**END OF SECTION 262816**

# SECTION 262913

## ENCLOSED CONTROLLERS

### 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 the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.
  - 2. Full-voltage magnetic.
- B. Related Section:
  - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

## **1.4 PERFORMANCE REQUIREMENTS**

## **1.5 SUBMITTALS**

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Nameplate legends.
    - d. Short-circuit current rating of integrated unit.
    - e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers 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. Routine maintenance requirements for enclosed controllers and installed components.
  - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
  - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

## **1.6 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 NFPA 70.

- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

## **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in 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. Notify Architect, Construction Manager, and Owner no fewer than two Insert number days in advance of proposed interruption of electrical systems.
  - 2. Indicate method of providing temporary utilities.
  - 3. Do not proceed with interruption of electrical systems without Architect's, Construction Manager's, and Owner's written permission.
  - 4. Comply with NFPA 70E.

## **1.9 COORDINATION**

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## **1.10 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. 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.
  - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Indicating Lights: Two of each type and color installed.

4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## **PART 2 - PRODUCTS**

### **2.1 FULL-VOLTAGE CONTROLLERS**

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing.
  3. Flush mounting.
  4. Red pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  4. Surface mounting.
  5. Red pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - c. Rockwell Automation, Inc.; Allen-Bradley brand.
  - d. Siemens Energy & Automation, Inc.
  - e. Square D; a brand of Schneider Electric.
- 2. Configuration: Nonreversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
  - 4. Surface mounting.
  - 5. Red pilot light.
  - 6. N.O. auxiliary contact.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 3. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 4. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. N.C. alarm contact that operates only when MCP has tripped.
  - 5. MCCB Disconnecting Means:

- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- d. N.C. alarm contact that operates only when MCCB has tripped.

## 2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  1. Dry and Clean Indoor Locations: Type 1.
  2. Outdoor Locations: Type 3R.
  3. Other Wet or Damp Indoor Locations: Type 4.
  4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

## 2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
    - a. Pilot Lights: **LED types; colors as indicated.**
    - b. Selector Switches: Rotary **type.**
- B. N.C. auxiliary contact(s).
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- D. Breather and drain assemblies, to maintain interior pressure and release condensation in enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- G. Cover gaskets for Type 1 enclosures.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

### **3.3 IDENTIFICATION**

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### **3.4 CONTROL WIRING INSTALLATION**

- A. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
  1. Inspect controllers, wiring, components, connections, and equipment installation.
  2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect, Construction Manager, and Owner before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.6 ADJUSTING**

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If

tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect, Construction Manager, and Owner before increasing settings.

- D. Set field-adjustable circuit-breaker trip ranges.

### **3.7 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

**END OF SECTION 262913**

# SECTION 265100 INTERIOR LIGHTING

## 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 lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Exterior luminaires normally mounted on exterior surfaces of buildings.

#### B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

### 1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

G. Warranty: Sample of special warranty.

## 1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. 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.

C. Comply with NFPA 70.

## 1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Fluorescent Ballast Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings or an approved equal.

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
  - a. "USE ONLY" and include specific lamp type.
  - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
  - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
  - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
  - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
  - f. CCT and CRI for all luminaires.

## 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

### A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.
11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires shall have programmed-start ballasts. Acceptable ballasts include Advance Optanium, GE Ultrastart, Sylvania QHE, or approved equal.

C. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

### D. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

## 2.4 BALLASTS FOR HID LAMPS

### A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F.

3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 20 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
10. Protection: Class P thermal cutout.

## 2.5 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
  1. Emergency Connection: Operate one fluorescent lamp continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

## 2.6 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

## 2.7 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature [3500] <Insert value> K, and average rated life 20,000 hours unless otherwise indicated.

## 2.8 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.

## 2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100