

SECTION 00001

**SOLERA SALON  
ALPHARETTA  
1655 MANSELL ROAD  
ALPHARETTA, GEORGIA**

**PROJECT MANUAL  
JULY 9, 2010**



**SECTION 00010**

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**SECTION 00100**

**BID SOLICITATION**

**FROM:**

**1.01 The Owner (hereinafter referred to as Owner:)**

- A. Handcoop Holdings @ Alpharetta, LLC
- B. 6160 S. Syracuse Way Suite 315
- C. Greenwood Village, CO 80111

**1.02 And the Architect (hereinafter referred to as Architect):**

- A. Mark Hoskin Architects
- B. 1732 Wazee Street Suite 201
- C. Denver, CO 80202

**1.03 DATE: .....**

**1.04 TO: POTENTIAL BIDDERS**

- A. Your firm is invited to submit an offer under seal to Owner for construction of a building located at 1655 Mansell Road, Alpharetta Georgia before 4:00 pm local daylight time on the 24th day of August, 2010, for the following project:
- B. All bidders are required to prequalify on or before 10:00 am on August 6, 2010. Utilize AIA Form A305.
- C. All bidders are required to prequalify to the requirements described in Document 00200 (00 2113) - Instructions to Bidders.
- D. Project Description: A Single free standing two story office building with stone and stucco veneer, site improvements and surface parking stalls.
- E. Bid Documents for a Stipulated Sum contract may be obtained from the office of the Design Professional free of charge upon receipt of a refundable deposit, by certified check, in the amount of \$150.00 for one set.
- F. Documents may be obtained only by general contract Bidders. Others may view the Bid Documents at the office of the Owner.
- G. Refer to other bidding requirements described in Document 00200 (00 2113) - Instructions to Bidders and Document 00300 - Information Available to Bidders.
- H. Submit your offer on the Bid Form provided. Bidders may supplement this form as appropriate.
- I. Your offer will be required to be submitted under a condition of irrevocability for a period of 30 days after submission.
- J. The Owner reserves the right to accept or reject any or all offers.

**1.05 SIGNATURE**

- A. For: .....
- B. By: .....
  - 1. Signed: \_\_\_\_\_
  - 2. (Authorized signing officer)

**ENCL.**

**END OF BID SOLICITATION**

## SECTION 00200

### INSTRUCTIONS TO BIDDERS

#### SUMMARY

##### 1.01 RELATED DOCUMENTS

- A. Document 00100 (00 1113) - Bid Solicitation.
- B. Document 00300 (00 3100) - Information Available To Bidders.
- C. Document 00410 (00 4100) - Bid Form.
- D. Document 00430 (00 4301) - Supplements to Bid Form.
- E. Document 00431 (00 4336) - Supplement A - List of Subcontractors.
- F. Document 00432 (00 4322) - Supplement B - List of Unit Prices.
- G. Document 00433 (00 4323) - Supplement C - List of Alternatives.
- H. Document 00434 (00 4327) - Supplement D - List of Separate Prices.
- I. Document 00435 (00 4373) - Supplement E - Cost Breakdown.
- J. Document 00436 (00 4334) - Supplement F - List of Supplementary Mechanical Information.
- K. Document 00437 (00 4335) - Supplement G - List of Supplementary Electrical Information.
- L. Document 00438 (00 4333) - Supplement H - List of Equipment.
- M. Document 00439 (00 4328) - Supplement I - List of Tax Rebate Items.
- N. Document 00800 (00 7300) - Supplementary Conditions:
  - 1. Contract Time identification.
  - 2. Tax and duty rebate procedures.
  - 3. Tax exempt procedures.
  - 4. Bond types and values.

#### INVITATION

##### 2.01 BID SUBMISSION

Bids signed, executed, and dated shall be received via e-mailed at the following addresses: **construction@solerasalon.com** and **mark@mha.bz** and followed with hard copies sent within two days of the bid deadline to the office of the Architect at 1732 Wazee Street, Denver, CO 80202. E-mail bids shall be received before 4:00 p.m. local daylight time on the 28th day of August.

- A. Offers submitted after the above time may be returned to the bidder unopened.
- B. Submit required Supplements To Bid Forms within 24 hours after closing time for receiving bids. □
- C. Amendments to the submitted offer will be permitted if received in writing prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer.

##### 2.02 INTENT

- A. The intent of this Bid request is to obtain an offer to perform work to complete a two story building located at 1655 Mansell Road, Alpharetta, Georgia for a Stipulated Sum contract, in accordance with the Contract Documents.

### **2.03 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS**

- A. Work of this proposed Contract comprises building construction and site development, including general construction, structural, mechanical, and electrical Work.

### **2.04 CONTRACT TIME**

- A. Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.
- B. Owner requires that under the work of this contract be completed as quickly as possible and consideration will be given to time of completion when reviewing the submitted bids.

## **BID DOCUMENTS AND CONTRACT DOCUMENTS**

### **3.01 DEFINITIONS**

- A. Bid Documents: Contract Documents supplemented with Invitation To Bid, Instructions to Bidders, Information Available to Bidders, Bid Form Supplements To Bid Forms and Appendices identified.
- B. Contract Documents: Defined in the List of Drawings, dated July 9, 2010, described in Section 00015 of the Project Manual, and the Project Manual, dated July 9, 2010 including issued Addenda.
- C. Bid, Offer, or Bidding: Act of submitting an offer under seal.
- D. Bid Amount: Monetary sum identified by the Bidder in the Bid Form.

### **3.02 CONTRACT DOCUMENTS IDENTIFICATION**

- A. The Contract Documents are identified as Project Number 1003, as prepared by Architect, and with contents as identified in the Project Manual.
- B. The Contract Documents are identified as Solera Salon Alpharetta.

### **3.03 AVAILABILITY**

- A. Bid documents may be obtained at by contacting the Owner.
- B. One sets of Bid Documents can be obtained by general contract bidders free of charge upon receipt of a refundable deposit, by certified check, in the amount of 150.00 for one set.
- C. Deposit will be refunded if Bid Documents are returned complete, undamaged, unmarked and reusable, within 7 days of bid submission. Failure to comply will result in forfeiture of deposit.
- D. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.

### **3.04 EXAMINATION**

- A. Bid Documents are on display at the offices of the following construction plan rooms:
  - 1. the Dodge Plan Room, Marietta, GA..
- B. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.
- C. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.

### **3.05 INQUIRIES/ADDENDA**

- A. Direct questions to Mark Hoskin Architects, e-mail mark@mha.bz.

- B. Addenda may be issued during the bidding period. All Addenda become part of the Contract Documents. Include resultant costs in the Bid Amount.
- C. Verbal answers are not binding on any party.
- D. Clarifications requested by bidders must be in writing not less than 7 days before date set for receipt of bids. The reply will be in the form of an Addendum, a copy of which will be forwarded to known recipients.

### **3.06 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS**

- A. Substitute products will be considered if submitted as an attachment to the Bid Form. Approval to submit substitutions prior to submission of bids is not required.
- B. When a request to substitute a product is made, Architect may approve the substitution and will issue an Addendum to known bidders.
- C. In submission of substitutions to products specified, bidders shall include in their bid all changes required in the Work and changes to Contract Time and Contract Sum to accommodate such substitutions. A later claim by the bidder for an addition to the Contract Time or Contract Sum because of changes in work necessitated by use of substitutions shall not be considered.
- D. The submission shall provide sufficient information to determine acceptability of such products.
- E. Provide complete information on required revisions to other work to accommodate each proposed substitution.
- F. Provide products as specified unless substitutions are submitted in this manner and accepted.
- G. See Section 01600 (01 6000) - Product Requirements for additional requirements.

## **SITE ASSESSMENT**

### **4.01 SITE EXAMINATION**

- A. Examine the project site before submitting a bid.
- B. The bidder is required to contact Owner at the following phone number in order to arrange a date and time to visit the project site: Matt Kennan - 720.235.4425.

### **4.02 PREBID CONFERENCE**

- A. A bidders conference has been scheduled for 10:00 a.m. on the 6th day of August at the location of 1655 Mansell Road, Alpharetta, Georgia.
- B. All general contract bidders and suppliers are invited.
- C. Representatives of Architect will be in attendance.

## **QUALIFICATIONS**

### **5.01 EVIDENCE OF QUALIFICATIONS**

- A. To demonstrate qualification for performing the Work of this Contract, bidders may be requested to submit written evidence of financial position, license to perform work in the State.

### **5.02 PREQUALIFICATION**

- A. Bidders shall complete and submit Qualification Form A305 to the Owner on or before 10:00 a.m. on the 6th day of August.

### **5.03 SUBCONTRACTORS/SUPPLIERS/OTHERS**

- A. Owner reserves the right to reject a proposed subcontractor for reasonable cause.

- B. Refer to General Conditions.

## **BID SUBMISSION**

### **6.01 SUBMISSION PROCEDURE**

- A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.
- B. Submit two copies of the executed offer on the Bid Forms provided, signed and sealed in a closed opaque envelope, clearly identified with bidder's name, project name and Owner's name on the outside.
- C. Electronic Bids: Bids may be submitted electronically via FAX to 720-235-4429 or via email to [construction@solerasalon.com](mailto:construction@solerasalon.com). [<>]
- D. Improperly completed information, irregularities in security deposit, may be cause not to open the Bid Form envelope and declare the bid invalid or informal.
- E. An abstract summary of submitted bids will be made available to all bidders following bid opening.

### **6.02 BID INELIGIBILITY**

- A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.
- B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be declared unacceptable.
- C. Failure to provide security deposit, bonding or insurance requirements may, at the discretion of Owner, be waived.
- D. Bids are by invitation, only from selected bidders. Bids from unsolicited bidders may be returned.

## **BID ENCLOSURES/REQUIREMENTS**

### **7.01 SECURITY DEPOSIT**

- A. Bids shall be accompanied by a security deposit as follows:
  - 1. Bid Bond in the amount of \$ TBD per Owner on AIA A310 Bid Bond Form.
  - 2. Certified check in the amount of \$TBD per Owner.
  - 3. Negotiable security.
- B. Endorse the Bid Bond in the name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.
- C. Endorse the certified check in the name of the Owner.
- D. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.
- E. Include the cost of bid security in the Bid Amount.
- F. After a bid has been accepted, all securities will be returned to the respective bidders and other requested enclosures.
- G. If no contract is awarded, all security deposits will be returned.

### **7.02 CONSENT OF SURETY**

- A. Submit with the Bid.

### **7.03 PERFORMANCE ASSURANCE**

- A. Accepted Bidder: Provide a Performance and Payment bond as described in Document 00800 - Supplementary Conditions.
- B. Include the cost of performance assurance bonds in the Bid Amount and identify the cost on the Bid Form.

### **7.04 INSURANCE**

- A. Provide an executed "Undertaking of Insurance" on the form provided stating their intention to provide insurance to the bidder in accordance with the insurance requirements of the Contract Documents.

### **7.05 BID FORM REQUIREMENTS**

- A. Complete all requested information in the Bid Form and Appendices.
- B. Taxes: Refer to Document 00800 (00 7300) - Supplementary Conditions for inclusion of taxes, procedures for tax rebate claims, and products that are tax exempt.

### **7.06 SALES AND USE TAXES**

- A. Include all state and local sales tax, use tax, and all other applicable taxes in the Cost of the Work.

### **7.07 FEES FOR CHANGES IN THE WORK**

- A. Include the fees for overhead and profit on own Work and Work by subcontractors, identified in Document 00800 (00 7300) - Supplementary Conditions.
- B. Include in the Bid Form, the overhead and profit fees on own Work and Work by subcontractors, applicable for Changes in the Work, whether additions to or deductions from the Work on which the Bid Amount is based.
- C. Include in the Bid Form, the fees proposed for subcontract work for changes (both additions and deductions) in the Work. Contractor shall apply fees as noted, to the subcontractor's gross (net plus fee) costs on additional work.

### **7.08 BID FORM SIGNATURE**

- A. The Bid Form shall be signed by the bidder, as follows:
  - 1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
  - 2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
  - 3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
  - 4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

### **7.09 ADDITIONAL BID INFORMATION**

- A. Submit the following Supplements 24 hours after bid submission:
  - 1. Document 00431 (00 4336) - Supplement A - Subcontractors: Include the names of all

- Subcontractors and the portions of the Work they will perform.
2. Document 00432 (00 4322) - Supplement B - Unit Prices: Include a listing of unit prices specifically requested by the Contract Documents.
  3. Document 00433 (00 4323) - Supplement C - Alternates: Include the cost variation to the Bid Amount applicable to the Work described in Section 00434.
  4. Document 00434 (00 4327) - Supplement D - Separate Prices: Include a listing of separate prices as specifically requested in the Contract Documents.
  5. Document 00435 (00 4373) - Supplement E - Cost Breakdown identifies the Bid Amount segmented into portions as requested.
  6. Document 00436 (00 4334) - Supplement F - Supplementary Mechanical Information.
  7. Document 00437 (00 4335) - Supplement G - Supplementary Electrical Information.
  8. Document 00438 (00 4333) - Supplement H - List of Equipment.
  9. Document 00439 (00 4328) - Supplement I - List of Tax Rebate Items.

#### **7.10 SELECTION AND AWARD OF ALTERNATIVES**

- A. Indicate variation of bid price for alternatives listed on the Bid Form. Unless otherwise indicated, indicate alternatives as a difference in bid price by adding to or deducting from the base bid price.
- B. Bids may be evaluated on the base bid price. After determination of a successful bidder, consideration will be given to alternatives and bid price adjustments.
- C. Bids will be evaluated on the total of the base bid price and all of the alternatives. After determination of the successful bidder, consideration will be given to which alternatives will be included in the Work.

#### **OFFER ACCEPTANCE/REJECTION**

##### **8.01 DURATION OF OFFER**

- A. Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the bid closing date.

##### **8.02 ACCEPTANCE OF OFFER**

- A. Owner reserves the right to accept or reject any or all offers.
- B. After acceptance by Owner, Architect on behalf of Owner, will issue to the successful bidder, a written Bid Acceptance.

#### **END OF INSTRUCTIONS TO BIDDERS**

## SECTION 00300

### AVAILABLE PROJECT INFORMATION

#### PART 1 GENERAL

##### 1.01 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of the Contract Documents, as follows:
- B. Site and Utility Survey: Entitled Alta/ACSM Land Title Survey for Handcoop @ Alpharett, LLC, dated February 19, 2010.
- C. Geotechnical Report: Entitled Report of Subsurface Exploration and Geotechnical Engineering Evaluation Proposed Solera Salon Facility 1655 Mansell Road Alpharetta, Fulton County, Georgia PGC Project No. 110022, dated February 17, 2010.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

#### EXISTING REPORTS AND SURVEYS

##### 4.01 SUBSURFACE INVESTIGATION REPORT

- A. A copy of a geotechnical report with respect to the building site is included with this document:
  - 1. Title: Report of Subsurface Exploration Geotechnical Engineering Evaluation Proposed Solera Salon Facility 1655 Mansell Road Alpharetta, Fulton County, Georgia PGC Project No. 110022
  - 2. Date: February 17, 2010
  - 3. Prepared by: Piedmont Geotechnical Consultants, INC.
- B. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
- C. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.
- D. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.

##### 4.02 TOPOGRAPHIC SURVEY

- A. A copy of a topographic survey with respect to the project site is included with this document:
  - 1. Title: Hancoop@Alpharetta, LLC Commonwealth Land Title Insurance Company
  - 2. Date: February 19, 2010
  - 3. Prepared by: GeoSurvey, LTD
- B. This survey identifies grade elevations prepared primarily for the use of Architect in establishing new grades and identifying natural water shed.

##### 4.03 EXISTING CONDITIONS SURVEY

- A. A copy of a survey with respect to the condition of the existing construction is available for viewing:
  - 1. Title: Hancoop@Alpharetta, LLC Commonwealth Land Title Insurance Company
  - 2. Date: February 19, 2010
  - 3. Prepared by: GeoSurvey, LTD

- B. This survey identifies conditions of existing construction prepared primarily for the use of Architect in establishing the extent of the new versus existing work.
- C. This survey includes a photographic record of existing conditions visible.

**END OF SECTION**

## **SECTION 00400**

### **PROCUREMENT FORMS AND SUPPLEMENTS**

#### **PART 1 GENERAL**

**1.01 Contractor is responsible for obtaining a valid license to use all copyrighted documents specified but not included in the Project Manual.**

#### **1.02 FORMS**

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the procurement requirements.
- B. Instructions to Bidders: AIA A701.
- C. Bid Form: Solera Salon Bid Breakout Form.
- D. Representations and Certifications:
  - 1. Proposer's Qualifications: AIA A305.

#### **1.03 REFERENCE STANDARDS**

- A. AIA A305 - Contractor's Qualification Statement; 1986.
- B. AIA A701 - Instructions to Bidders; 1997.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 00410**

**BID FORM**

**THE PROJECT AND THE PARTIES**

**1.01 TO:**

A. Owner

1. \_\_\_\_\_
2. \_\_\_\_\_

B. \_\_\_\_\_ (Owner)

1. \_\_\_\_\_
2. \_\_\_\_\_

**1.02 FOR:**

A. \_\_\_\_\_

**1.03 DATE:** \_\_\_\_\_ (Bidder to enter date)

**1.04 SUBMITTED BY: (Bidder to enter name and address)**

A. Bidder's Full Name \_\_\_\_\_

1. Address \_\_\_\_\_
2. City, State, Zip \_\_\_\_\_

**1.05 OFFER**

A. Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Mark Hoskin Architects (MHA) for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

B. \_\_\_\_\_ dollars  
(\$ \_\_\_\_\_), in lawful money of the United States of America.

C. We have included the required security deposit as required by the Instruction to Bidders.

D. All applicable federal, local and use taxes are included and State of Georgia taxes are included in the Bid Sum.

E. All Cash and Contingency Allowances described in Section 01210 (01 2100) are included in the Bid Sum.

**1.06 ACCEPTANCE**

A. This offer shall be open to acceptance and is irrevocable for sixty days from the bid closing date.

B. If this bid is accepted by Owner within the time period stated above, we will:

1. Execute the Agreement within seven days of receipt of Notice of Award.
2. Furnish the required bonds within seven days of receipt of Notice of Award.
3. Commence work within seven days after written Notice to Proceed of this bid.

C. If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

- D. In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

### 1.07 CONTRACT TIME

- A. If this Bid is accepted, we will:
- B. Complete the Work by the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_. (Bidder to enter day, month, and year.)

### 1.08 UNIT PRICES

- A. The following are Unit Prices for specific portions of the Work as listed. The following is the list of Unit Prices:
- B. ITEM DESCRIPTION - UNIT QUANTITY - UNIT PRICE - ITEM VALUE
- C. \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \$ .....
- D. \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \$ .....
- E. \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \$ .....
- F. \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \$ .....

### 1.09 CHANGES TO THE WORK

- A. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
1. \_\_\_\_\_ percent overhead and profit on the net cost of our own Work;
  2. \_\_\_\_\_ percent on the cost of work done by any Subcontractor.
- B. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus \_\_\_\_\_ of the overhead and profit percentage noted above.

### 1.10 ADDENDA

- A. The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.
1. Addendum # \_\_\_\_\_ Dated \_\_\_\_\_.
  2. Addendum # \_\_\_\_\_ Dated \_\_\_\_\_.

### 1.11 BID FORM SUPPLEMENTS

- A. The following information is included with Bid submission:
1. Subcontractors: \_\_\_\_\_.
  2. Unit Prices: \_\_\_\_\_.
  3. Alternatives: \_\_\_\_\_.
- B. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:
1. Document 00431 (00 4336) - Supplement A - Subcontractors: Include the names of all Subcontractors and the portions of the Work they will perform.
  2. Document 00432 (00 4322) - Supplement B - Unit Prices: Include a listing of unit prices specifically requested by the Contract Documents.
  3. Document 00433 (00 4323) - Supplement C - Alternatives: Include the cost variations to the Bid Sum applicable to the Work as described in Section \_\_\_\_\_.
  4. Document 00434 (00 4327) - Supplement D - Separate Prices: Include a listing of separate prices as specifically requested in the Contract Documents.

5. Document 00435 (00 4373) - Supplement E - Cost Breakdown identifies the Bid Sum segmented into portions as requested.
  6. Document 00438 (00 4333) - Supplement H - List of Equipment.
  7. Document 00439 (00 4328) - Supplement I - List of Tax Rebate Items.
- C. We agree to submit the following Supplements to Bid Forms within 24 hours after submission of this bid for additional bid information:
1. Document 00431 (00 4336) - Supplement A - Subcontractors: Include the names of all Subcontractors and the portions of the Work they will perform.
  2. Document 00432 (00 4322) - Supplement B - Unit Prices: Include a listing of unit prices specifically requested by the Contract Documents.
  3. Document 00433 (00 4323) - Supplement C - Alternatives: Include the cost variations to the Bid Price applicable to the Work as described in Section \_\_\_\_\_.
  4. Document 00434 (00 4327) - Supplement D - Separate Prices: Include a listing of separate prices as specifically requested in the Contract Documents.
  5. Document 00435 (00 4373) - Supplement E - Cost Breakdown identifies the Bid Price/Sum segmented into portions as requested.
  6. Document 00436 (00 4334) - Supplement F - Supplementary Mechanical Information.
  7. Document 00437 (00 4335) - Supplement G - Supplementary Electrical Information.
  8. Document 00438 (00 4333) - Supplement H - List of Equipment.
  9. Document 00439 (00 4328) - Supplement I - List of Tax Rebate Items.

**1.12 BID FORM SIGNATURE(S)**

- A. The Corporate Seal of
- B. \_\_\_\_\_
- C. (Bidder - print the full name of your firm)
- D. was hereunto affixed in the presence of:
- E. \_\_\_\_\_
- F. (Authorized signing officer, Title)
- G. (Seal)
- H. \_\_\_\_\_
- I. (Authorized signing officer, Title)

**1.13 If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.**

**END OF BID FORM**



**SECTION 00430**

**SUPPLEMENTS TO BID FORM**

**PARTICULARS**

**1.01 TO:**.....

**1.02 Project:** .....

**1.03 Date:** \_\_\_\_\_

**1.04 Submitted by: (Bidder to insert full name and address)**

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. In accordance with Document 00200 (00 2113) Instructions to Bidders and Document 00410 (00 4100) - Bid Form, we include the Supplements To Bid Form listed below. The information provided shall be considered an integral part of the Bid Form.

**1.05 SUPPLEMENTS TO BID FORM**

A. ....

B. ....

**SIGNATURE(S)**

**2.01 The Corporate Seal of**

A. \_\_\_\_\_

B. (Bidder please print the full name of your Proprietorship, Partnership, or Corporation)

**2.02 was hereunto affixed in the presence of:**

A. \_\_\_\_\_

B. (Authorized signing officer                      Title)

**2.03 (Seal)**

A. \_\_\_\_\_

B. (Authorized signing officer                      Title)

**2.04 (Seal)**

**END OF SUPPLEMENTS TO BID FORM**



**SECTION 00431**

**SUPPLEMENT A - LIST OF SUBCONTRACTORS**

**PARTICULARS**

**1.01 Herewith is the list of Subcontractors referenced in the bid submitted by:**

**1.02 To (Owner) .....**

**1.03 Dated \_\_\_\_\_ and which is an integral part of the Bid Form.**

**1.04 The following work will be performed (or provided) by Subcontractors and coordinated by us:**

**LIST OF SUBCONTRACTORS**

**2.01 WORK SUBJECT.....SUBCONTRACTOR NAME**

**2.02 .....**

**2.03 .....**

**2.04 .....**

**2.05 .....**

**END OF SUPPLEMENT A**



**SECTION 00433**

**SUPPLEMENT C - LIST OF ALTERNATIVES**

**PARTICULARS**

**1.01** The following is the list of Alternatives referenced in the bid submitted by:

**1.02** (Bidder) \_\_\_\_\_

**1.03** TO (Owner) .....

**1.04** Dated \_\_\_\_\_ and which is an integral part of the Bid Form.

**ALTERNATIVES LIST**

**2.01** The following amounts shall be added to or deducted from the Bid Amount. Refer to Section 01230 (01 2300) - Alternatives: Schedule of Alternatives.

**2.02** Alternative # 1: (Add) (Deduct) \$ \_\_\_\_\_

**2.03** Alternative # 2: (Add) (Deduct) \$ \_\_\_\_\_

**2.04** Alternative # 3: (Add) (Deduct) \$ \_\_\_\_\_

**2.05** Alternative # 4: (Add) (Deduct) \$ \_\_\_\_\_

**2.06** Alternative # 5: (Add) (Deduct) \$ \_\_\_\_\_

**2.07** Alternative # 6: (Add) (Deduct) \$ \_\_\_\_\_

**2.08** Alternative # 7: (Add) (Deduct) \$ \_\_\_\_\_

**2.09** Alternative # 8: (Add) (Deduct) \$ \_\_\_\_\_

**END OF SUPPLEMENT C**



SECTION 00434

SUPPLEMENT D - SEPARATE PRICES FORM

PARTICULARS

THE FOLLOWING IS THE LIST OF SEPARATE PRICES REFERENCED IN THE BID SUBMITTED BY:  
(BIDDER) \_\_\_\_\_

TO OWNER: HANDCOOP HOLDINGS AT ALPHARETTA, LLC

DATED \_\_\_\_\_ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

ITEM DESCRIPTIONS

6.01 Item # 1:

- A. Description: Building and Site Demolition
- B. Value: \$ \_\_\_\_\_

6.02 Item # 2:

- A. Description: Reuse Existing Switch Gear and Electrical Distribution Panels
- B. Value: \$ \_\_\_\_\_

6.03 Item # 3:

- A. Description: Awnings and Gooseneck Fixtures on the South Elevation
- B. Value: \$ \_\_\_\_\_

6.04 Item # 4:

- A. Description: \_\_\_\_\_
- B. Value: \$ \_\_\_\_\_

6.05 Item # 5:

- A. Description: \_\_\_\_\_
- B. Value: \$ \_\_\_\_\_
- C.

END OF FORM



**SECTION 00435**

**SUPPLEMENT E - COST BREAKDOWN**

**PARTICULARS**

**1.01** The following is a Cost Breakdown referenced in the bid submitted by:

**1.02** (Bidder) \_\_\_\_\_

**1.03** TO (Owner) .....

**1.04** Dated \_\_\_\_\_ and which is an integral part of the Bid Form.

**ITEM DESCRIPTIONS**

**2.01** Item #1:

A. Description: .....

B. Overhead and Profit Included.

C. Value: \$ \_\_\_\_\_

**END OF SUPPLEMENT E**



**SECTION 00436**

**SUPPLEMENT F - LIST OF SUPPLEMENTARY MECHANICAL INFORMATION**

**PARTICULARS**

**1.01 The following is the list of Supplementary Mechanical Information referenced in the bid submitted by:**

**1.02 (Bidder) \_\_\_\_\_**

**1.03 TO (Owner) .....**

**1.04 Dated \_\_\_\_\_ and which is an integral part of the Bid Form.**

**COMPONENT/ITEM DESCRIPTIONS**

**2.01 Item #1:**

A. Description: .....

B. Manufacturer: \_\_\_\_\_

**END OF SUPPLEMENT F**

**SECTION 00437**

**SUPPLEMENT G - LIST OF SUPPLEMENTARY ELECTRICAL INFORMATION**

**PARTICULARS**

**1.01** The following is the list of Supplementary Electrical Information referenced in the bid submitted by:

**1.02** (Bidder) \_\_\_\_\_

**1.03** TO (Owner) .....

**1.04** dated \_\_\_\_\_ and which is an integral part of the Bid Form.

**LIST**

**2.01** COMPONENT OR ITEM ----- MANUFACTURER

**2.02** ..... \_\_\_\_\_

**2.03** ..... \_\_\_\_\_

**END OF SUPPLEMENT G**

**SECTION 00438**

**SUPPLEMENT H - LIST OF EQUIPMENT**

**PARTICULARS**

**1.01** The following is the List of Equipment referenced in the bid submitted by:

**1.02** (Bidder) \_\_\_\_\_

**1.03** TO (Owner) .....

**1.04** dated \_\_\_\_\_ and which is an integral part of the Bid Form.

**LIST**

**2.01** COMPONENT OR ITEM ----- MANUFACTURER

**2.02** ..... \_\_\_\_\_

**2.03** ..... \_\_\_\_\_

**END OF SUPPLEMENT H**



---

**END OF FORM**

**SECTION 00500**

**AGREEMENT**

**PART 1 GENERAL**

**1.01 FORM OF AGREEMENT**

**1.02 The Agreement to be executed is attached following this page.**

**1.03 RELATED REQUIREMENTS**

- A. Section 00700 - General Conditions.
- B. Section 00800 - Supplementary Conditions.
- C. Section 01422 - Definitions.

**1.04 MODIFICATIONS TO THE AGREEMENT FORM**

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF AGREEMENT**

## SECTION 00590

### CONTRACTING FORMS AND SUPPLEMENTS

#### PART 1 GENERAL

**1.01 Contractor is responsible for obtaining a valid license to use all copyrighted documents specified but not included in the Project Manual.**

#### 1.02 AGREEMENT AND CONDITIONS OF THE CONTRACT

- A. See Section 00500 (00 5200) for the Agreement form to be executed.
- B. See Section 00700 (00 7200) for the General Conditions.
- C. See Section 00800 (00 7300) for the Supplementary Conditions.
- D. The Agreement form is AIA A101.
- E. The General Conditions are AIA A201.

#### 1.03 FORMS

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.
- B. Bond Forms:
  - 1. Performance and Payment Bond Form: AIA A312.
  - 2. Performance Bond for Erosion and Sedimentation Control: See Section 015713.
- C. Post-Award Certificates and Other Forms:
  - 1. Submittal Transmittal Form: AIA G810.
  - 2. Schedule of Values Form: AIA G703.
  - 3. Schedule of Values Form: Owners form To Be Determined.
  - 4. Application for Payment Form: AIA G702 and G703.
- D. Clarification and Modification Forms:
  - 1. Supplemental Instruction Form: AIA G710.
  - 2. Construction Change Directive Form: AIA G714.
  - 3. Change Order Form: AIA G701.
- E. Closeout Forms:
  - 1. Certificate of Substantial Completion Form: AIA G704.
  - 2. Warranty Form: \_\_\_\_\_.
  - 3. Statutory Declaration Form: \_\_\_\_\_.

#### 1.04 REFERENCE STANDARDS

- A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum; 2007.
- B. AIA A201 - General Conditions of the Contract for Construction; 2007.
- C. AIA A312 - Performance Bond and Payment Bond; 1984.
- D. AIA G701 - Change Order; 2001.
- E. AIA G702 - Application and Certificate for Payment; 1992.
- F. AIA G703 - Continuation Sheet; 1992.
- G. AIA G704 - Certificate of Substantial Completion; 2000.
- H. AIA G710 - Architect's Supplemental Instructions; 1992.

I. AIA G714 - Construction Change Directive; 2007.

J. AIA G810 - Transmittal Letter; 2001.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 00910**

**ADDENDUM NUMBER 1**

**PARTICULARS**

**1.01 DATE:** .....

**1.02 PROJECT:** .....

**1.03 PROJECT NUMBER:**.....

**1.04 OWNER:** .....

**1.05 ARCHITECT:**.....

**TO: PROSPECTIVE BIDDERS**

**2.01 This Addendum forms a part of the Contract Documents and modifies the Bidding Documents dated \_\_\_\_\_, and Addendum Number \_\_\_\_ issued \_\_\_\_\_, with amendments and additions noted below.**

**2.02 Acknowledge receipt of this Addendum in the space provided in the Bid Form. Failure to do so may disqualify the Bidder.**

**2.03 This Addendum consists of 1 page and the following Drawings:**

A. ....

B. ....

**CHANGES TO ADDENDA**

**3.01 CHANGES TO ADDENDUM NUMBER \_\_\_\_ - Issued \_\_\_\_\_**

A. ....

B. ....

**CHANGES TO THE PROJECT MANUAL**

**4.01 TABLE OF CONTENTS**

A. ....

B. ....

**4.02 DOCUMENT 00200 (00 2113) - INSTRUCTIONS TO BIDDERS**

A. ....

B. ....

**4.03 SECTION \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**4.04 SECTION \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**CHANGES TO THE PROJECT MANUAL**

**5.01 SECTION \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**CHANGES TO THE DRAWINGS**

**6.01 DRAWING \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**6.02 DRAWING \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**6.03 DRAWING \_\_\_\_\_ - \_\_\_\_\_**

A. ....

B. ....

**6.04 APPROVAL OF ADDITIONAL PRODUCTS/SYSTEMS**

A. ....

B. ....

**END OF ADDENDUM NUMBER \_\_\_**

## SECTION 01100

### SUMMARY

#### PART 1 GENERAL

##### 1.01 PROJECT

- A. Project Name: Solera Salon Alpharetta.
- B. Owner's Name: Handcoop @ Alpharetta LLC.
- C. The Project consists of the demolition of an existing one story restaurant and the construction of a two story building with site improvements.

##### 1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00500 - Agreement.

##### 1.03 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is shown on drawings and specified in Section 02225.
- B. Scope of alterations work is shown on drawings.
- C. Owner will remove at his/her option the following items before start of work: Any items remaining shall be disposed of by the General Contractor.
  - 1. Furnishings.
  - 2. Art.
  - 3. Kitchen Equipment.
  - 4. Fixtures of his/her choosing.
- D. Contractor shall remove and store the following prior to start of work, for later reinstallation by Contractor:
  - 1. Electrical switch gear and panels.
  - 2. Steel site fencing adjacent to the Gazebo.

##### 1.04 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
  - 1. Movable cabinets.
  - 2. Furnishings.
  - 3. Small equipment.
  - 4. Rugs.
  - 5. Artwork.
- B. Owner will supply the following for installation by Contractor: Contractor shall receive, unload, uncrate, inspect, store and install these items:
  - 1. Shampoo Sinks and Hair traps.
  - 2. Cafe Equipment.
  - 3. Lounge Room Appliances.

##### 1.05 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

## **1.06 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Utility Outages and Shutdown:
  - 1. Prevent accidental disruption of utility services to other facilities.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01200

### PRICE AND PAYMENT PROCEDURES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

##### 1.02 RELATED REQUIREMENTS

- A. Section 00590 (00 5000) - Contracting Forms and Supplements: Forms to be used.
- B. Document 00500 (00 5200) - Agreement: Contract Sum, retainages, payment period, monetary values of unit prices.
- C. Document 00700 (00 7200) - General Conditions and Document 00800 - Supplementary Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- D. Document 00800 (00 7300) - Supplementary Conditions: Percentage allowances for Contractor's overhead and profit.
- E. Section 01210 (01 2100) - Allowances: Payment procedures relating to allowances.
- F. Section 01270 (01 2200) - Unit Prices: Monetary values of unit prices, payment and modification procedures relating to unit prices.

##### 1.03 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.
- E. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.

##### 1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- H. Submit three copies of each Application for Payment.
- I. Include the following with the application:
  - 1. Transmittal letter as specified for Submittals in Section 01300 (01 3000).
  - 2. Construction progress schedule, revised and current as specified in Section 01300 (01 3000).
  - 3. Current construction photographs specified in Section 01300 (01 3000).
  - 4. Partial release of liens from major Subcontractors and vendors for payments in excess of \$2,500.00.
  - 5. Project record documents as specified in Section 01780 (01 7800), for review by Owner which will be returned to the Contractor.
  - 6. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

#### **1.05 MODIFICATION PROCEDURES**

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  - 2. Promptly execute the change.

- D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
- E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01600 (01 6000).
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
  - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- G. Substantiation of Costs: Provide full information required for evaluation.
  - 1. On request, provide following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  - 2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

#### **1.06 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 01700 (01 7000).
2. Certificate of Occupancy.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01210

### ALLOWANCES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Cash allowances.
- B. Contingency allowance.
- C. Inspecting and testing allowances.
- D. Payment and modification procedures relating to allowances.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01200 (01 2000) - Price and Payment Procedures: Additional payment and modification procedures.

##### 1.03 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site, less applicable taxes.
- B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing..
- C. Architect Responsibilities:
  - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
  - 2. Select products in consultation with Owner and transmit decision to Contractor.
  - 3. Prepare Change Order.
- D. Contractor Responsibilities:
  - 1. Assist Architect in selection of products, suppliers, and installers.
  - 2. Obtain proposals from suppliers and installers and offer recommendations.
  - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
  - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
  - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

##### 1.04 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
- B. Funds will be drawn from the Contingency Allowance only by Change Order.
- C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

##### 1.05 INSPECTING AND TESTING ALLOWANCES

- A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.
- B. Costs Not Included in the Inspecting and Testing Allowances:

1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
  2. Costs of testing services used by Contractor separate from Contract Document requirements.
  3. Costs of retesting upon failure of previous tests as determined by Architect.
- C. Payment Procedures:
1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.
  2. Pay invoice on approval by Architect.
- D. Differences in cost will be adjusted by Change Order.

**1.06 ALLOWANCES SCHEDULE**

- A. Include the stipulated sum of \$3,000.00 for purchase, delivery, and installation of Gas BBQ Grill and the construction of a masonry and stone base.
- B. Section 09650: Include the unit price of \$8.00 per sq.ft for purchase, delivery, and installation of vinyl flooring.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01230

### ALTERNATIVES

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#### **PART 1 GENERAL**

##### **3.01 SECTION INCLUDES**

- A. Description of alternates.
- B. Procedures for pricing alternates.
- C. Documentation of changes to Contract Sum and Contract Time.

##### **3.02 RELATED REQUIREMENTS**

- A. Document 00200 (00 2113) - Instructions to Bidders: Instructions for preparation of pricing for alternatives.
- B. Document 00433 (00 4323) - Supplement C - Alternatives: List of alternatives as supplement to Bid Form.
- C. Document 00500 (00 5200) - Agreement: Incorporating monetary value of accepted alternatives.

##### **3.03 ACCEPTANCE OF ALTERNATES**

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

##### **3.04 SCHEDULE OF ALTERNATES**

- A. Alternate No. 1 - Installation of canvas awnings, frames, structure, electrical and gooseneck light fixtures above first floor windows, south elevation to match others indicated elsewhere. :
- B. Alternate No. 2 - Salvaged Electrical gear and panels from existing one story building at 1655 Mansell Road:
- C. Alternate No. 3 - Reuse salvaged Electrical gear and panels in new construction at 1655 Mansell Road.:
- D. Alternate No. 4 - Stained Concrete at the ramp, steps, raised entry patio and stair landing extending north into the parking lot.:
- E. Alternate No. 5 - Energy Recovery System with exhaust system and ductwork:

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## SECTION 01270

### UNIT PRICES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Measurement and payment criteria applicable to Work performed under a unit price payment method.
- C. Defect assessment and non-payment for rejected work.

##### 1.02 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

##### 1.03 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

##### 1.04 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Assist by providing necessary equipment, workers, and survey personnel as required.
- C. Measurement Devices:
  - 1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
  - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
  - 3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.
- D. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- E. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- F. Measurement by Area: Measured by square dimension using mean length and width or radius.
- G. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- H. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- I. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes, calculate and certify quantities for payment purposes.

##### 1.05 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

- B. Payment will not be made for any of the following:
  - 1. Products wasted or disposed of in a manner that is not acceptable.
  - 2. Products determined as unacceptable before or after placement.
  - 3. Products not completely unloaded from the transporting vehicle.
  - 4. Products placed beyond the lines and levels of the required Work.
  - 5. Products remaining on hand after completion of the Work.
  - 6. Loading, hauling, and disposing of rejected Products.

#### **1.06 DEFECT ASSESSMENT**

- A. Replace Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
  - 1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Architect.
  - 2. The defective Work will be partially repaired to the instructions of the Architect, and the unit price will be adjusted to a new unit price at the discretion of Architect.
- C. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
  - 1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
  - 2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.
- D. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.

#### **1.07 SCHEDULE OF UNIT PRICES**

- A. None

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01300

### ADMINISTRATIVE REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Site mobilization meeting.
- C. Progress meetings.
- D. Construction progress schedule.
- E. Progress photographs.
- F. Coordination drawings.
- G. Submittals for review, information, and project closeout.
- H. Number of copies of submittals.
- I. Submittal procedures.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01810 (01 9113) - Commissioning: Additional procedures for submittals relating to commissioning.
  - 1. Where submittals are indicated for review by both Architect and the Commissioning Authority, submit one extra and route to Architect first, for forwarding to the Commissioning Authority.
  - 2. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Authority; otherwise, the procedures specified in this section apply to commissioning submittals.

##### 1.03 PROJECT COORDINATION

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
  - 1. Requests for interpretation.
  - 2. Requests for substitution.
  - 3. Shop drawings, product data, and samples.
  - 4. Test and inspection reports.
  - 5. Design data.
  - 6. Manufacturer's instructions and field reports.
  - 7. Applications for payment and change order requests.

8. Progress schedules.
9. Coordination drawings.
10. Closeout submittals.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 PRECONSTRUCTION MEETING**

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
  1. Owner.
  2. Architect.
  3. Contractor.
  4. Civil Engineer.
- C. Agenda:
  1. Execution of Owner-Contractor Agreement.
  2. Submission of executed bonds and insurance certificates.
  3. Distribution of Contract Documents.
  4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  5. Designation of personnel representing the parties to Contract, Civil Engineer and Architect.
  6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  7. Scheduling.
  8. Scheduling activities of a Geotechnical Engineer.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.02 SITE MOBILIZATION MEETING**

- A. Owner will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
  1. Contractor.
  2. Owner.
  3. Architect.
  4. Special Consultants.
  5. Contractor's Superintendent.
  6. Major Subcontractors.
- C. Agenda:
  1. Use of premises by Owner and Contractor.
  2. Owner's requirements and occupancy prior to completion.
  3. Construction facilities and controls provided by Owner.
  4. Temporary utilities provided by Owner.
  5. Survey and building layout.
  6. Security and housekeeping procedures.
  7. Schedules.
  8. Application for payment procedures.
  9. Procedures for testing.
  10. Procedures for maintaining record documents.
  11. Requirements for start-up of equipment.
  12. Inspection and acceptance of equipment put into service during construction period.

- D. Contractor to record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.03 PROGRESS MEETINGS**

- A. Contractor to schedule and administer meetings throughout progress of the Work at maximum weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Contractor's Project Manager, Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Review of off-site fabrication and delivery schedules.
  - 7. Maintenance of progress schedule.
  - 8. Corrective measures to regain projected schedules.
  - 9. Planned progress during succeeding work period.
  - 10. Coordination of projected progress.
  - 11. Maintenance of quality and work standards.
  - 12. Effect of proposed changes on progress schedule and coordination.
  - 13. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 CONSTRUCTION PROGRESS SCHEDULE**

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
  - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

### **3.05 PROGRESS PHOTOGRAPHS**

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- C. Photography Type: Digital; electronic files.
- D. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.

- E. In addition to periodic, recurring views, take photographs of each of the following events:
  1. Completion of site clearing.
  2. Excavations in progress.
  3. Foundations in progress and upon completion.
  4. Structural framing in progress and upon completion.
  5. Enclosure of building, upon completion.
  6. Final completion, minimum of ten (10) photos.
- F. Take photographs as evidence of existing project conditions as follows:
  1. At contractors discretion.
  2. As requested by owner or architect.
- G. Views:
  1. Provide daily non-aerial photographs from four cardinal views at each specified time, until Date of Substantial Completion.
  2. Consult with Architect for instructions on views required.
  3. Provide factual presentation.
  4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
  5. Point of View Sketch: Provide sketch identifying point of view of each photograph.
- H. Digital Photographs: 24 bit color, minimum resolution of 4M, in JPG format; provide files unaltered by photo editing software.
  1. Delivery Medium: Via email.
  2. File Naming: Include date and time of view.

### **3.06 COORDINATION DRAWINGS**

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

### **3.07 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.
  3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01780 (01 7800) - CLOSEOUT SUBMITTALS.

### **3.08 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  1. Design data.
  2. Certificates.
  3. Test reports.
  4. Inspection reports.
  5. Manufacturer's instructions.
  6. Manufacturer's field reports.
  7. Other types indicated.

- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

### **3.09 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
  - 1. Project record documents.
  - 2. Operation and maintenance data.
  - 3. Warranties.
  - 4. Bonds.
  - 5. HVAC Test and Balance Report.
  - 6. Inspection Reports and Testing Logs.
  - 7. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

### **3.10 NUMBER OF COPIES OF SUBMITTALS**

- A. Documents for Review:
  - 1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.
  - 2. Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.
- B. Documents for Information: Submit two copies.
- C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
  - 1. After review, produce duplicates.
  - 2. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.11 SUBMITTAL PROCEDURES**

- A. Transmit each submittal with AIA Form G810.
- B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- E. Deliver submittals to Architect at business address.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.

- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.

**END OF SECTION**

**SECTION 01325**

**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PRELIMINARY SCHEDULE**

**END OF SECTION**

## SECTION 01400

### QUALITY REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Quality assurance submittals.
- B. Mock-ups.
- C. Control of installation.
- D. Tolerances.
- E. Testing and inspection services.
- F. Manufacturers' field services.

##### 1.02 RELATED REQUIREMENTS

- A. Document 00300 - Information Available to Bidders: Soil investigation data.
- B. Document 00700 - General Conditions: Inspections and approvals required by public authorities.
- C. Section 01210 - Allowances: Allowance for payment of testing services.
- D. Section 01300 - Administrative Requirements: Submittal procedures.
- E. Section 01422 - Definitions.
- F. Section 01425 - Reference Standards.
- G. Section 01600 - Product Requirements: Requirements for material and product quality.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008.
- B. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2009.
- C. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2009.
- D. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2008.
- E. ASTM E 329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2009.
- F. ASTM E 543 - Standard Specification for Agencies Performing Nondestructive Testing; 2009.

##### 1.04 SUBMITTALS

- A. Testing Agency Qualifications:
  - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Conformance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.
  - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
  - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
  - 1. Submit report in duplicate within 30 days of observation to Architect for information.
  - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
  - 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
  - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

#### **1.05 REFERENCES AND STANDARDS**

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### **1.06 TESTING AND INSPECTION AGENCIES**

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01210; see Section 01210 and applicable sections for description of services included in allowance.
- B. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- C. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- D. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- E. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- F. Contractor Employed Agency:
  1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
  2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
  3. Laboratory: Authorized to operate in the state in which the Project is located.
  4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
  5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

### **3.02 MOCK-UPS**

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

### **3.03 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### **3.04 TESTING AND INSPECTION**

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. Attend preconstruction meetings and progress meetings.
  - 8. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.05 MANUFACTURERS' FIELD SERVICES**

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and \_\_\_\_\_ as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
1. Observer subject to approval of Architect.
  2. Observer subject to approval of Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

### **3.06 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION**

## **SECTION 01422**

### **DEFINITIONS**

#### **PART 1 GENERAL**

##### **1.01 SUMMARY**

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

##### **1.02 DEFINITIONS**

- A. **Furnish:** To supply, deliver, unload, and inspect for damage.
- B. **Install:** To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. **Product:** Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. **Project Manual:** The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. **Provide:** To furnish and install.
- F. **Supply:** Same as Furnish.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## **SECTION 01425**

### **REFERENCE STANDARDS**

#### **PART 1 GENERAL**

##### **1.01 QUALITY ASSURANCE**

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

**END OF SECTION**

## SECTION 01500

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01510 (01 5100) - Temporary Utilities.
- B. Section 01525 (01 5213) - Field Offices.
- C. Section 01550 (01 5500) - Vehicular Access and Parking.
- D. Section 01565 (01 3553) - Security Measures.
- E. Section 01585 (01 5813) - Project Signs.

##### 1.03 TEMPORARY UTILITIES - See Section 01510 (01 5100)

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Existing facilities may be used.
- C. New permanent facilities may be used.
- D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

##### 1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization. Owner and Owner's designated agents shall have full use of all job site telecommunication facilities.
- B. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
  - 2. Telephone Land Lines: One line, minimum; one handset per line and one speakerphone with teleconference ability.
  - 3. Internet Connections: Minimum of one; DSL modem or faster, with wireless internet access for use by Owner and Owner's designated agents.
  - 4. Email: Account/address reserved for project use.

5. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.
6. Facsimile Service: Fax-to-email software on personal computer.

#### **1.05 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. New permanent facilities may not be used during construction operations.
- C. Maintain daily in clean and sanitary condition.
- D. At end of construction, return facilities to same or better condition as originally found.

#### **1.06 BARRIERS**

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

#### **1.07 FENCING**

- A. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

#### **1.08 EXTERIOR ENCLOSURES**

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

#### **1.09 INTERIOR ENCLOSURES**

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

#### **1.10 SECURITY - See Section 01565 (01 3553)**

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

#### **1.11 VEHICULAR ACCESS AND PARKING - See Section 01550 (01 5500)**

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.

- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

#### **1.12 WASTE REMOVAL**

- A. See Section 01732 (01 7419) - Waste Management, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### **1.13 PROJECT IDENTIFICATION**

- A. Provide project identification sign of design, construction, and location approved by Owner.
- B. No other signs are allowed without Owner permission except those required by law.

#### **1.14 FIELD OFFICES - See Section 01525 (01 5213)**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

#### **1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## SECTION 01510

### TEMPORARY UTILITIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, and water.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01500 - Temporary Facilities and Controls:
  - 1. Temporary telecommunications services for administrative purposes.
  - 2. Temporary sanitary facilities required by law.

##### 1.03 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Power Service Characteristics: \_\_\_\_ volt, \_\_\_\_ ampere, three phase, four wire.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- D. Provide main service disconnect and over-current protection at convenient location and meter.
- E. Permanent convenience receptacles may be utilized during construction.
- F. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

##### 1.04 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft (21 watt/sq m).
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.

##### 1.05 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

##### 1.06 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

- C. Maintain maximum ambient temperature of 80 degrees F (26 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

**1.07 TEMPORARY VENTILATION**

**1.08 TEMPORARY WATER SERVICE**

- A. Cost of Water Used: By Contractor.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- C. Connect to existing water source.
  - 1. Exercise measures to conserve water.
  - 2. Provide separate metering and reimburse Owner for cost of water used.
- D. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## **SECTION 01525**

### **FIELD OFFICES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Temporary field offices for use of Owner and Architect.
- B. Temporary field offices for use of Contractor.
- C. Maintenance and removal.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01100 (01 1000) - Summary: use of premises and responsibility for providing field offices.
- B. Section 01500 (01 5000) - Temporary Facilities and Controls:
  - 1. Temporary telecommunications services for administrative purposes.
  - 2. Temporary sanitary facilities required by law.
- C. Section 01500 (01 5000) - Temporary Facilities and Controls: Parking and access to field offices.
- D. Section 01550 (01 5500) - Vehicular Access and Parking: Parking and access to field offices.

#### **PART 2 PRODUCTS**

##### **2.01 MATERIALS, EQUIPMENT, FURNISHINGS**

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

##### **2.02 CONSTRUCTION**

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove when no longer needed.
- C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy requirements.
- D. Exterior Materials: Weather resistant, finished in one color.
- E. Interior Materials in Offices: Sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for Offices: 50 fc (538 lx) at desk top height, exterior lighting at entrance doors.
- G. Fire Extinguishers: Appropriate type fire extinguisher at each office.

##### **2.03 ENVIRONMENTAL CONTROL**

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

##### **2.04 Contractor OFFICE AND FACILITIES**

- A. Size: For Contractor's needs and to provide space for project meetings. Contractor shall provide a separate lockable room for use by Owner and Owner's designated agents.
- B. Telephone: As specified in Section 01500 (01 5000).

- C. Furnishings in Meeting Area: Conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents. Owner's office shall include a chair, desk, and a wireless internet connection.
- D. Other Furnishings: Contractor's option.
- E. Equipment: Six adjustable band protective helmets for visitors, one 10 inch (250 mm) outdoor weather thermometer.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

#### **3.02 INSTALLATION**

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
- B. Employee Residential Occupancy: Not allowed on Owner's property.

#### **3.03 MAINTENANCE AND CLEANING**

- A. Weekly janitorial services for offices; periodic cleaning and maintenance for offices.
- B. Maintain approach walks free of mud, water, and snow.

#### **3.04 REMOVAL**

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

**END OF SECTION**

## SECTION 01575

### TEMPORARY EROSION AND SEDIMENTATION CONTROL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Performance bond.
- E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

##### 1.02 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Comply with all requirements of The City of Alpharetta for erosion and sedimentation control.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
- E. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 150 percent of the cost of erosion and sedimentation control work.
- F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
  - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
  - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
  - 1. Control movement of sediment and soil from temporary stockpiles of soil.
  - 2. Prevent development of ruts due to equipment and vehicular traffic.
  - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
  - 1. Prevent windblown soil from leaving the project site.
  - 2. Prevent tracking of mud onto public roads outside site.

3. Prevent mud and sediment from flowing onto sidewalks and pavements.
  4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
  2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

### **1.03 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
1. Include:
    - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
    - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
    - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
    - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
    - e. Other information required by law.
    - f. Format required by law is acceptable, provided any additional information specified is also included.
  2. Obtain the approval of the Plan by authorities having jurisdiction.
  3. Obtain the approval of the Plan by Owner.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

### **3.02 PREPARATION**

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

### **3.03 INSTALLATION**

### **3.04 MAINTENANCE**

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Clean out temporary sediment control structures weekly and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

### **3.05 CLEAN UP**

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

**END OF SECTION**



## **SECTION 01585**

### **PROJECT SIGNS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Project identification sign.
- B. Project informational signs.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01100 (01 1000) - Summary: Responsibility to provide signs.

##### **1.03 REFERENCE STANDARDS**

##### **1.04 QUALITY ASSURANCE**

- A. Design sign and structure to withstand 50 miles/hr (80 km/hr) wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

##### **1.05 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

#### **PART 2 PRODUCTS**

##### **2.01 SIGN MATERIALS**

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of color as selected.

##### **2.02 PROJECT IDENTIFICATION SIGN**

- A. One painted sign, 48 sq ft (4.5 sq m) area, bottom 6 feet (2 m) above ground.
- B. Content:
  - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
  - 2. Names and titles of authorities.
  - 3. Names and titles of Architect and Consultants.
  - 4. Name of Prime Contractor and major Subcontractors.

##### **2.03 PROJECT INFORMATIONAL SIGNS**

- A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot (30 m) distance.
- B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

- C. Provide municipal traffic agency directional traffic signs to and within site.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at designated location.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces of sign, supports, and framing.

#### **3.02 MAINTENANCE**

- A. Maintain signs and supports clean, repair deterioration and damage.

#### **3.03 REMOVAL**

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

**END OF SECTION**

## SECTION 01600

### PRODUCT REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

##### 1.02 RELATED REQUIREMENTS

- A. Document 00200 (00 2113) - Instructions to Bidders: Product options and substitution procedures prior to bid date.
- B. Section 01100 (01 1000) - Summary: Lists of products to be removed from existing building.
- C. Section 01400 (01 4000) - Quality Requirements: Product quality monitoring.
- D. Section 01616 (01 6116) - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- E. Section 01732 (01 7419) - Waste Management: Waste disposal requirements potentially affecting packaging and substitutions.

##### 1.03 REFERENCE STANDARDS

- A. 16 CFR 260 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; current edition.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

##### 1.04 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

#### PART 2 PRODUCTS

##### 2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.

##### 2.02 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

### **PART 3 EXECUTION**

#### **3.01 SUBSTITUTION PROCEDURES**

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  - 2. Will provide the same warranty for the substitution as for the specified product.
  - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- D. Substitution Submittal Procedure:
  - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
  - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  - 3. The Architect will notify Contractor in writing of decision to accept or reject request.

#### **3.02 OWNER-SUPPLIED PRODUCTS**

- A. Owner's Responsibilities:
  - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
  - 2. Arrange and pay for product delivery to site.
  - 3. On delivery, inspect products jointly with Contractor.
  - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
  - 1. Review Owner reviewed shop drawings, product data, and samples.
  - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  - 3. Handle, store, install and finish products.
  - 4. Repair or replace items damaged after receipt.

#### **3.03 TRANSPORTATION AND HANDLING**

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

#### **3.04 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**



## SECTION 01700

### EXECUTION REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Cutting and patching.
- C. Surveying for laying out the work.
- D. Cleaning and protection.
- E. Starting of systems and equipment.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, except payment procedures.
- H. General requirements for maintenance service.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01300 (01 3000) - Administrative Requirements: Submittals procedures.
- B. Section 01400 (01 4000) - Quality Requirements: Testing and inspection procedures.
- C. Section 01500 (01 5000) - Temporary Facilities and Controls: Temporary exterior enclosures.
- D. Section 01500 (01 5000) - Temporary Facilities and Controls: Temporary interior partitions.
- E. Section 01510 (01 5100) - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- F. Section 01575 (01 5713) - Temporary Erosion and Sedimentation Control: Additional erosion and sedimentation control requirements.
- G. Section 01732 (01 7419) - Waste Management: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- H. Section 01780 (01 7800) - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- I. Section 01810 (01 9113) - Commissioning: Contractor's responsibilities in regard to commissioning.
- J. Section 07840 (07 8400) - Firestopping.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.

2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.
6. Include in request:
  - a. Identification of Project.
  - b. Location and description of affected work.
  - c. Necessity for cutting or alteration.
  - d. Description of proposed work and products to be used.
  - e. Effect on work of Owner or separate Contractor.
  - f. Written permission of affected separate Contractor.
  - g. Date and time work will be executed.

#### **1.04 QUALIFICATIONS**

- A. For survey work, employ a land surveyor registered in the state in which the Project is located and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

#### **1.05 PROJECT CONDITIONS**

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

#### **1.06 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01600 (01 6000).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.03 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar

appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  2. Grid or axis for structures.
  3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.04 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.05 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07840 (07 8400), to full thickness of the penetrated element.
- I. Patching:
  1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  2. Match color, texture, and appearance.

3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.06 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.07 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### **3.08 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.09 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01820 (01 7900) - Demonstration and Training.

### **3.10 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Testing, adjusting, and balancing HVAC systems: See Section 15950 (23 0593).

### **3.11 FINAL CLEANING**

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.12 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Notify Architect when work is considered ready for Substantial Completion.
- C. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.
- D. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.
- E. Notify Architect when work is considered finally complete.
- F. Complete items of work determined by Architect's final inspection.

### **3.13 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION**



## SECTION 01732

### WASTE MANAGEMENT

#### PART 1 GENERAL

##### 1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- E. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

##### 1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.

- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

### **1.03 SUBMITTALS**

- A. See Section 01300 - Administrative Requirements, for submittal procedures.

## **PART 3 EXECUTION**

### **2.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 01300 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01500 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01600 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01700 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

### **2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
  1. Pre-bid meeting.
  2. Pre-construction meeting.
  3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  1. Provide containers as required.
  2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION**

## SECTION 01734

### INDOOR AIR QUALITY

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.

##### 1.02 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
  - 1. Cleaning of ductwork is not contemplated under this Contract.
  - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
  - 1. Furnish products meeting the specifications.
  - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

##### 1.03 RELATED REQUIREMENTS

- A. Section 15860 - Air Cleaning Devices: HVAC filters.
- B. Section 15950 - Testing, Adjusting, and Balancing: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

##### 1.04 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

#### PART 3 EXECUTION

##### 2.01 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
  - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
  - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
  - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. HVAC equipment and supply air ductwork may be used for ventilation during construction:
  - 1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
  - 2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
- D. Do not store construction materials or waste in mechanical or electrical rooms.

- E. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
  - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
  - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
  - 3. Clean tops of doors and frames.
  - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
  - 5. Clean return plenums of air handling units.
  - 6. Remove intake filters last, after cleaning is complete.
- F. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- G. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

**END OF SECTION**

## SECTION 01780

### CLOSEOUT SUBMITTALS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

##### 1.02 RELATED REQUIREMENTS

- A. Section 00700 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01300 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01700 - Execution Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

##### 1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
  - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
  - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
  - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

#### PART 3 EXECUTION

##### 2.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.

4. Change Orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
  - C. Store record documents separate from documents used for construction.
  - D. Record information concurrent with construction progress.
  - E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
    1. Manufacturer's name and product model and number.
    2. Product substitutions or alternates utilized.
    3. Changes made by Addenda and modifications.
  - F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
    1. Field changes of dimension and detail.
    2. Details not on original Contract drawings.

## **2.02 OPERATION AND MAINTENANCE DATA**

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

## **2.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

## **2.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  1. Description of unit or system, and component parts.
  2. Identify function, normal operating characteristics, and limiting conditions.
  3. Include performance curves, with engineering data and tests.
  4. Complete nomenclature and model number of replaceable parts.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- D. Provide servicing and lubrication schedule, and list of lubricants required.

- E. Include manufacturer's printed operation and maintenance instructions.
- F. Include sequence of operation by controls manufacturer.
- G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- H. Additional Requirements: As specified in individual product specification sections.

## **2.05 OPERATION AND MAINTENANCE MANUALS**

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop drawings and product data.
    - b. Air and water balance reports.
    - c. Certificates.
    - d. Photocopies of warranties and bonds.
- J. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

## **2.06 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

**END OF SECTION**

## SECTION 01810

### COMMISSIONING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
  - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
  - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
  - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
  - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion
- C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
- D. The Commissioning Authority is employed by Owner.

##### 1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Plumbing Systems:
  - 1. Water heaters.
  - 2. Booster pumps.
  - 3. Landscape irrigation.
- C. HVAC System, including:
  - 1. Major and minor equipment items.
  - 2. Piping systems and equipment.
  - 3. Ductwork and accessories.
  - 4. Terminal units.
  - 5. Control system.
- D. Special Ventilation:
  - 1. Specialty fans.
- E. Electrical Systems:
  - 1. Power quality.
- F. Electronic Safety and Security:
  - 1. Security system, including doors and hardware.
  - 2. Fire and smoke alarms.
- G. Communications:
  - 1. Voice and data systems.

- H. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

### **1.03 REFERENCE STANDARDS**

- A. PECl (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Portland Energy Conservation, Inc.; located at <http://www.peci.org/library/mcpgs.htm>; current edition.

### **1.04 SUBMITTALS**

- A. See Section 01300 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2003 preferred.
  - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- C. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
  - 1. Manufacturer's product data, cut sheets, and shop drawings.
  - 2. Manufacturer's installation instructions.
  - 3. Startup, operating, and troubleshooting procedures.
  - 4. Fan and pump curves.
  - 5. Factory test reports.
  - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

## **PART 2 PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
  - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
  - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.

3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
  - D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
    1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

### **PART 3 EXECUTION**

#### **3.01 COMMISSIONING PLAN**

- A. Commissioning Authority has prepared the Commissioning Plan.
  1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
  2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
  1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
  2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
  3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
  4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

#### **3.02 STARTUP PLANS AND REPORTS**

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

#### **3.03 PREFUNCTIONAL CHECKLISTS**

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
  1. No sampling of identical or near-identical items is allowed.
  2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
  3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
    - a. Certification by installing contractor that the unit is properly installed, started up, and

- operating and ready for Functional Testing.
  - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
  - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
  - d. Serial number of installed unit.
  - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
  - f. Sensor and actuator calibration information.
4. Samples of Prefunctional Checklist forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
  2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
  3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
  4. If any Checklist line item is not relevant, record reasons on the form.
  5. Contractor may independently perform startup inspections and/or tests, at his option.
  6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
  7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
  2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
  3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
  4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
  2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

### 3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
  - 1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
  - 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
  - 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
  - 4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
  - 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
  - 1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
  - 2. Examples of Functional Testing:
    - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
    - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
    - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
    - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
  - 3. Samples of Functional Test forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.

- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

### 3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
  2. Verify that sensors with shielded cable are grounded only at one end.
  3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
  4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
  2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
  3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
  2. Connect a signal generator in place of sensor.
  3. Connect ammeter in series between transmitter and building automation system control panel.
  4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
  5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
  6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
  7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
  8. Reconnect sensor.
  9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
  10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
  11. If not, replace sensor and repeat.
  12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
  2. Pressure, Air, Water, Gas: 3 percent of design.
  3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).

4. Relative Humidity: 4 percent of design.
  5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
  6. Flow Rate, Air: 10 percent of design.
  7. Flow Rate, Water: 4 percent of design.
  8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
  2. Set pump/fan to normal operating mode.
  3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
  4. Command valve/damper to open; verify position is full open and adjust output signal as required.
  5. Command valve/damper to a few intermediate positions.
  6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
  2. Use an ultra-sonic flow meter to detect flow or leakage.

### **3.06 TEST PROCEDURES - GENERAL**

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
  2. Sampling is not allowed for:
    - a. Major equipment.
    - b. Life-safety-critical equipment.
    - c. Prefunctional Checklist execution.
  3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
  4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
  5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
  6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
  7. If YY percent of the units in the second sample fail, test all remaining identical units.
  8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

- D. **Manual Testing:** Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. **Simulating Conditions:** Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. **Simulating Signals:** Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. **Over-Writing Values:** Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. **Indirect Indicators:** Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. **Monitoring:** Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
  - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
  - 2. Other points will be monitored by the Commissioning Authority using dataloggers.
  - 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
  - 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
  - 5. Graphical output is desirable and is required for all output if the system can produce it.
  - 6. Monitoring may be used to augment manual testing.

### **3.07 OPERATION AND MAINTENANCE MANUALS**

- A. See Section 01780 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

**END OF SECTION**

## SECTION 01820

### DEMONSTRATION AND TRAINING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. All software-operated systems.
  - 2. HVAC systems and equipment.
  - 3. Plumbing equipment.
  - 4. Electrical systems and equipment.
  - 5. Conveying systems.
  - 6. Landscape irrigation.
  - 7. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
  - 2. Finishes, including flooring, wall finishes, ceiling finishes.
  - 3. Fixtures and fittings.
  - 4. Items specified in individual product Sections.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01780 - Closeout Submittals: Operation and maintenance manuals.
- B. Section 01810 - Commissioning: Additional requirements applicable to demonstration and training.
- C. Other Specification Sections: Additional requirements for demonstration and training.

##### 1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Architect for transmittal to Owner.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    - g. Media to be used, such as slides, hand-outs, etc.
    - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.

2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

#### **1.04 QUALITY ASSURANCE**

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  1. Perform demonstrations not less than two weeks prior to Substantial Completion.

##### **3.02 TRAINING - GENERAL**

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
  1. Review the applicable O&M manuals.
  2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.

3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  4. Provide hands-on training on all operational modes possible and preventive maintenance.
  5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  6. Discuss common troubleshooting problems and solutions.
  7. Discuss any peculiarities of equipment installation or operation.
  8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  10. Review spare parts and tools required to be furnished by Contractor.
  11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**

## SECTION 02225

### DEMOLITION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Abandonment and removal of existing utilities and utility structures.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01100 (01 1000) - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01100 (01 1000) - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01500 (01 5000) - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01575 (01 5713) - Temporary Erosion and Sedimentation Control.
- E. Section 01600 (01 6000) - Product Requirements: Handling and storage of items removed for salvage and relocation.
- F. Section 01700 (01 7000) - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- G. Section 01732 (01 7419) - Waste Management: Limitations on disposal of removed materials; requirements for recycling.
- H. Section 02230 (31 1000) - Site Clearing: Vegetation and existing debris removal.
- I. Section 02310 (31 2200) - Grading: Topsoil removal.
- J. Section 02316 (31 2323) - Fill and Backfill: Filling holes, pits, and excavations generated as a result of removal operations.

##### 1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Vegetation to be protected.
  - 2. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

##### 1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

#### PART 3 EXECUTION

### **3.01 SCOPE**

- A. Remove the entire building designated on the drawings.
- B. Remove paving and curbs as required to accomplish new work.
- C. Remove steel pipe parking lot gates and foundations upon substantial completion of project or at owners request.
- D. Remove other items indicated, for salvage, relocation, and recycling.

### **3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Use of explosives is not permitted.
  - 3. Provide, erect, and maintain temporary barriers and security devices.
  - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 5. Do not close or obstruct roadways or sidewalks without permit.
  - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Perform demolition in a manner that maximizes salvage and recycling of materials.
  - 1. Comply with requirements of Section 01732 (01 7419) - Waste Management.
  - 2. Dismantle existing construction and separate materials.
  - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- G. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

### **3.03 EXISTING UTILITIES**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.

- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

#### **3.04 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01732 (01 7419) - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION**



## SECTION 02230

### SITE CLEARING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01100 (01 1000) - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01500 (01 5000) - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01575 (01 5713) - Temporary Erosion and Sedimentation Control.
- D. Section 01700 (01 7000) - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 01732 (01 7419) - Waste Management: Limitations on disposal of removed materials; requirements for recycling.
- F. Section 02225 (02 4100) - Demolition: Removal of built elements and utilities.
- G. Section 02310 (31 2200) - Grading: Topsoil removal.
- H. Section 02310 (31 2200) - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

##### 1.03 QUALITY ASSURANCE

- A. Clearing Firm: Company specializing in the type of work required.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Fill Material: As specified in Section 02310 (31 2200) - Grading

#### PART 3 EXECUTION

##### 3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01700 (01 7000).
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

##### 3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

##### 3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, lawns, and planting beds.
- B. Do not remove or damage vegetation beyond the property lines or limits indicated on drawings.
- C. Install substantial, highly visible fences at least 3 feet (1 m) high to prevent inadvertent damage to vegetation to remain:
  - 1. At vegetation removal limits.
  - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
- D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
  - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
  - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
  - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
  - 4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- F. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

### **3.04 DEBRIS**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION**

## SECTION 02310

### GRADING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Removal and storage of topsoil.
- B. Rough grading the site for site structures, building pads, and parking.
- C. Finish grading.

##### 1.02 RELATED REQUIREMENTS

- A. Section 02230 (31 1000) - Site Clearing.
- B. Section 02315 (31 2316) - Excavation.
- C. Section 02316 (31 2323) - Fill and Backfill: Filling and compaction.
- D. Section 02923 (32 9223) - Sodding: Finish ground cover.
- E. Section 02930 (32 9300) - Exterior Plants: Topsoil in beds and pits.

##### 1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with Municipality of Overland Park, Public Works Department standards.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Topsoil: See Section 02316 (31 2323).

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

##### 3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- D. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.

##### 3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

#### **3.04 FINISH GRADING**

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- E. Place topsoil to the following compacted thicknesses:
  - 1. Areas to be Sodded: 4 inches (100 mm).
  - 2. Shrub Beds: 18 inches (450 mm).
  - 3. Flower Beds: 12 inches (300 mm).
- F. Remove roots, weeds, rocks, and foreign material while spreading.
- G. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

#### **3.05 REPAIR AND RESTORATION**

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

#### **3.06 FIELD QUALITY CONTROL**

- A. See Section 02316 (31 2323) for compaction density testing.

**END OF SECTION**

## SECTION 02315

### EXCAVATION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

##### 1.02 RELATED REQUIREMENTS

- A. Document Piedmont Geotechnical Consultants Document #110022: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 02310 (31 2200) - Grading: Soil removal from surface of site.
- C. Section 02310 (31 2200) - Grading: Grading.
- D. Section 02316 (31 2323) - Fill and Backfill: Fill materials, filling, and compacting.
- E. Section 02620 (33 4600) - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

##### 1.03 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

##### 3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 02310 (31 2200) for additional requirements.

##### 3.03 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut utility trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 02316 (31 2323).
- H. Grade top perimeter of excavation to prevent surface water from draining into excavation.

- I. Remove excavated material that is unsuitable for re-use from site.
- J. Remove excess excavated material from site.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

#### **3.05 PROTECTION**

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

**END OF SECTION**

## SECTION 02316

### FILL AND BACKFILL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

##### 1.02 RELATED REQUIREMENTS

- A. Document Piedmont Geotechnical Consultants, INC PGC Project No. 110022: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 02310 (31 2200) - Grading: Site grading.
- C. Section 02315 (31 2316) - Excavation: Removal and handling of soil to be re-used.
- D. Section 02620 (33 4600) - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

##### 1.03 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2009.
- B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2007.
- C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2007.
- E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- G. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. When necessary, store materials on site in advance of need.

## **PART 2 PRODUCTS**

### **2.01 FILL MATERIALS**

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 02310 (31 2200) for additional requirements.

### **3.02 PREPARATION**

- A. Scarify subgrade surface to a depth of 6 inches (150 mm) to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

### **3.03 FILLING**

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Slope grade away from building minimum 2 inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- G. Correct areas that are over-excavated.
  - 1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- H. Compaction Density Unless Otherwise Specified or Indicated:
- I. Reshape and re-compact fills subjected to vehicular traffic.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests: Refer to Geotechnical Report PGC Project no.110022.

**3.05 CLEANING**

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

**END OF SECTION**



## SECTION 02741

### BITUMINOUS CONCRETE PAVING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Single course bituminous concrete paving.
- C. Double course bituminous concrete paving.

##### 1.02 RELATED REQUIREMENTS

- A. Section 02310 (31 2200) - Grading: Preparation of site for paving and base.
- B. Section 02316 (31 2323) - Fill and Backfill: Compacted subgrade for paving.
- C. Section 02843 (32 1713) - Parking Bumpers: Concrete bumpers.
- D. Section 09900 (09 9000) - Paints and Coatings: Pavement markings.

##### 1.03 REFERENCE STANDARDS

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1994.

##### 1.04 QUALITY ASSURANCE

- A. Obtain materials from same source throughout.

##### 1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.

##### 1.06 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees (8 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Aggregate for Base Course: Angular crushed washed stone; free of shale, clay, friable material and debris.

##### 2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

##### 3.02 BASE COURSE

- A. Place and compact base course.

### **3.03 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Place asphalt within 24 hours of applying primer or tack coat.
- B. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- C. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### **3.04 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place wearing course within two hours of placing and compacting binder course.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

### **3.05 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.
- B. Variation from True Elevation: Within 1/2 inch (12 mm).

### **3.06 PROTECTION**

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F (60 degrees C).

**END OF SECTION**

## SECTION 02751

### PORTLAND CEMENT CONCRETE PAVING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete sidewalks, stair steps, integral curbs, gutters, median barriers, parking areas, and roads.

##### 1.02 RELATED REQUIREMENTS

- A. Section 02310 (31 2200) - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- B. Section 02316 (31 2323) - Fill and Backfill: Compacted subbase for paving.
- C. Section 02640 (33 0513) - Manholes and Covers: Manholes including frames.
- D. Section 02843 (32 1713) - Parking Bumpers: Precast concrete parking bumpers.
- E. Section 03100 (03 1000) - Concrete Forms and Accessories.
- F. Section 03200 (03 2000) - Concrete Reinforcement.
- G. Section 03300 (03 3000) - Cast-in-Place Concrete.
- H. Section 07900 (07 9005) - Joint Sealers: Sealant for joints.
- I. Section 09900 (09 9000) - Paints and Coatings: Pavement markings.

##### 1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988 (Reapproved 2002).
- F. ASTM A 185/A 185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- G. ASTM A 497/A 497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.
- H. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- I. ASTM C 33 - Standard Specification for Concrete Aggregates; 2007.
- J. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.
- K. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2007.
- L. ASTM C 150 - Standard Specification for Portland Cement; 2007.

- M. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2006.
- N. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.
- O. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2008a.
- P. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2008).
- Q. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2008).

#### **1.04 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

### **PART 2 PRODUCTS**

#### **2.01 PAVING ASSEMBLIES**

- A. Comply with applicable requirements of ACI 301.
- B. Design paving for parking and light duty commercial vehicles.
- C. Concrete Sidewalks and Median Barrier: 3,000 psi (20.7 MPa) 28 day concrete, 4 inches (100 mm) thick, Portland cement, broom finish.
- D. Parking Area Pavement: 4,000 psi (27.6 MPa) 28 day concrete, 5 inches (125 mm) thick, 6/6 - 6 x 6 inch mesh reinforcement, wood float finish.

#### **2.02 FORM MATERIALS**

- A. Form Materials: Conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
  - 1. Thickness: 1/2 inch (12 mm).

#### **2.03 REINFORCEMENT**

- A. Reinforcing Steel and Welded Wire Reinforcement: Types specified in Section 03200 (03 2000).
- B. Dowels: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.

#### **2.04 CONCRETE MATERIALS**

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: As specified in Section 03300 (03 3000).

#### **2.05 ACCESSORIES**

- A. Curing Compound: ASTM C 309, Type 1, Class A.

#### **2.06 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

## **2.07 MIXING**

- A. Transit Mixers: Comply with ASTM C 94/C 94M.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

### **3.02 SUBBASE**

### **3.03 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

### **3.04 FORMING**

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

### **3.05 REINFORCEMENT**

- A. Place reinforcement as indicated.
- B. Place dowels to achieve pavement and curb alignment as detailed.

### **3.06 COLD AND HOT WEATHER CONCRETING**

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

### **3.07 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
- B. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

### **3.08 JOINTS**

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch (10 mm) wide expansion joints at 20 foot (6 m) intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
  - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch (13 mm) of finished surface.
  - 2. Secure to resist movement by wet concrete.
- C. Provide sawn joints:

1. At 5 feet (1.5 m) intervals.

### **3.09 FINISHING**

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch (6 mm) radius.
- C. Median Barrier: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch (6 mm) radius.
- D. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- E. Inclined Vehicular Ramps: Broomed perpendicular to slope.
- F. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

### **3.10 JOINT SEALING**

- A. See Section 07900 (07 9005) for joint sealer requirements.

### **3.11 TOLERANCES**

- A. Maximum Variation of Surface Flatness: 1/4 inch (6 mm) in 10 ft (3 m).
- B. Maximum Variation From True Position: 1/4 inch (6 mm).

### **3.12 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01400 (01 4000).
  1. Provide free access to concrete operations at project site and cooperate with appointed firm.
  2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd (57 cu m) or less of concrete placed.
  1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
  2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

### **3.13 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

**END OF SECTION**

## SECTION 02765

### PAVEMENT MARKINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.
- B. Roadway lane markings and crosswalk markings.
- C. "No Parking" curb painting.

##### 1.02 RELATED REQUIREMENTS

- A. Section 02741 - Bituminous Concrete Paving.
- B. Section 02751 - Portland Cement Concrete Paving.

##### 1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; <http://mutcd.fhwa.dot.gov>; current edition.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

##### 1.05 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Line and Zone Marking Paint: MPI No. 97 Latex Traffic Marking Paint; color(s) as indicated.
  - 1. Roadway Markings: As required by authorities having jurisdiction.
  - 2. Parking Lots: to match color of development
  - 3. Handicapped Symbols: Blue.
- B. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
  - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- F. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
  - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
  - 2. At Contractor's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

### 3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F (10 degrees C) or more than 95 degrees F (35 degrees C).
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends.
  - 1. Apply paint in one coat only.
  - 2. Wet Film Thickness: 0.015 inch (0.4 mm), minimum.
  - 3. Width Tolerance: Plus or minus 1/8 inch (3 mm).
- G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
  - 1. Conduct operations in such a manner that necessary traffic can move without hindrance.
  - 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
  - 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.

4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as required by authorities having jurisdiction.
  5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
1. Mark the International Handicapped Symbol at indicated parking spaces.
  2. Hand application by pneumatic spray is acceptable.
- I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

### **3.04 DRYING, PROTECTION, AND REPLACEMENT**

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

**END OF SECTION**

## SECTION 02843

### PARKING BUMPERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.

##### 1.02 REFERENCE STANDARDS

- A. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- B. ASTM C 33 - Standard Specification for Concrete Aggregates; 2007.
- C. ASTM C 150 - Standard Specification for Portland Cement; 2007.
- D. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2006.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Parking Bumpers: Precast concrete, conforming to the following:
  - 1. Profile: Manufacturer's standard.
  - 2. Cement: ASTM C 150, Portland Type I - Normal; gray color.
  - 3. Concrete Materials: ASTM C 33 aggregate, water, and sand.
  - 4. Reinforcing Steel: ASTM A 615/A 615M, deformed steel bars; unfinished finish, strength and size commensurate with precast unit design.
  - 5. Air Entrainment Admixture: ASTM C 260.
  - 6. Concrete Mix: Minimum 5000 psi (34 MPa), 28 day strength, air entrained to 5 to 7 percent.
  - 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
  - 8. Embed reinforcing steel, and drill or sleeve for 4 dowels.
  - 9. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
  - 10. Minor patching in plant is acceptable, providing appearance of units is not impaired.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 4 dowels per unit.

END OF SECTION

**CONCRETE WORK**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including Division-0; Division-1; Division-2; Division-4; Division-5, Division-7; Division-9; Division-13.

1.2 DESCRIPTION:

- A. The extent of cast-in-place concrete work is shown on the drawings.

1.3 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards; except where more stringent requirements are shown or specified:
  - B. ACI 301 "Specifications for Structural Concrete for Buildings".
  - C. ACI 318 "Building Code Requirements for Reinforced Concrete".
  - D. ACI 347 "Recommended Practice for Concrete Formwork".
  - E. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
  - F. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by the Architect.
  - G. Concrete Testing Service: Owner shall employ a testing laboratory for material evaluation tests and to perform sampling and testing of concrete during placement.
  - H. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
  - I. Comply with the provisions of Section 01400.
  - J. Quality Control Testing During Construction: Testing laboratory shall sample and test concrete for quality control during the placement of concrete as follows:
    - 1. Sampling Fresh Concrete: ASTM C-172, except modified for slump to Comply with ASTM C-94.
    - 2. Slump: ASTM C-143; one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
    - 3. Air Content: ASTM C-173 volumetric method for normal and lightweight concrete; one for each set of compressive strength test specimens.
    - 4. Compressive Test Specimen: ASTM C-31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed.

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5. Compressive Strength Tests: ASTM C-39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required. One additional cylinder will be cast and tested at 56 days for 6000 psi, and 7000 psi concrete and above, as applicable.
6. When the total quantity of a given class of concrete is less than 20 cu. yds., the strength test may be waived by the Architect if, in his judgement, adequate evidence of satisfactory strength is provided.

- L. Test results will be reported in writing to the Architect and the Contractor on the same day that tests are made.
- M. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. The testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C-42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

### 1.4 SUBMITTALS:

- A. General: Submit shop drawings and product data in accordance with the provisions of Section 01300.
- B. Shop Drawings: Submit shop drawings for fabrications, bending and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams for bent bars, arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures. Shop drawings must be reviewed and marked approved by the Contractor prior to submittal to the Architect.
- C. Mix Design: Submit to Architect five (5) copies of mix design for concrete at least 15 days prior to delivery of concrete to project site. Contractor must review and approve mix design prior to submitting to the Architect.
- D. Material Certificates: Provide materials certificates signed by the Manufacturer and the Contractor, certifying that each material item complies with, or exceeds, the specified requirements.

### 1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver products to site and store in accordance with the provisions of Section 01620.

## PART 2 - PRODUCTS

### 2.1 FORM MATERIALS:

- A. Forms: Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces.
- B. Fiber forms for Round Columns: Fiber round column forms shall be Alton sleek/tubes standard walls, Sonoco Products Sontotube regular 'A' coated or equal, of size required on drawings.

- C. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water of curing compound.

2.2 REINFORCING MATERIALS:

- A. Reinforcing Bar: ASTM A-615, Grade 60 deformed.
- B. Epoxy Coated Reinforcing Bar: ASTM A-775
- C. Steel Wire: ASTM A-82, plain, cold-drawn steel.
- D. Welded Wire Fabric: ASTM A-185, flat mat welded steel wire fabric.
- E. Supports for Reinforcement: Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Wood, brick and other devices will not be acceptable.

2.3 CONCRETE MATERIALS:

- A. Portland Cement: ASTM C-150, Type 1 unless otherwise acceptable to Architect.
- B. Normal Weight Aggregates: ASTM C-33, and as herein specified. Provide aggregates from a single source for all exposed concrete.
- C. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
- D. Maximum Aggregate Size: Not larger than 3/4", nor three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars, except when approved otherwise by Architect. Maximum aggregate for steel-pan stair fill and thin slabs 3" thick and less, shall be "
- E. Water: Clean, fresh, potable.
- F. Air Entraining Admixture: ASTM C-260.
- G. Calcium Chloride: Calcium chloride for admixtures containing more than 0.1% chloride ions shall not be permitted.
- H. Preformed Expansion Joint Material: W.R. Meadows "Cermar" flexible foam, closed cell or approved equal.
- I. Membrane Forming Curing Compound: ASTM C-309, Type 1d with fugitive dye, unless other type acceptable to the Architect.
- J. Membrane Curing Compound: (For Vertical Surfaces)
- K. Moisture Barrier: Refer to Section 07190 - Vapor Barrier

2.4 PROPORTIONING AND DESIGN OF MIXES:

- A. Prepare design mixes for each type and strength of concrete in accordance with applicable

provisions of ASTM C-94.

- B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.
- C. Submit written reports to the Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Each mix design shall be identified by a number or code unique to that mix.
- D. Design mixes to provide normal weight concrete with the 28 day psi compressive strength as indicated on drawings and schedules.
- E. Admixtures: Use air entraining admixture in all exterior exposed concrete, unless otherwise indicated. Add air entraining admixture at the Manufacturer's prescribed rate to result in concrete at the point of placement having air content within the following limits: All concrete, 3% to 5% unless otherwise approved by Engineer.
- F. Use admixtures for water reducing and set control (with written permission of Architect).
- G. Slump Limits: Slump range shall be 4"-6" for all structural concrete except caissons shall have a maximum 8" slump.

2.5 CONCRETE MIXING:

- A. Ready-Mix Concrete: Comply with the requirements of ASTM C-94 and as herein specified.

2.6 CONCRETE ACCESSORIES:

- A. Refer to Section 03320 when post tensioning is required.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Construct forms complying with ACI 347 to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
- B. Chamfer exposed corners and edges 3/4" as shown, using wood, metal PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- C. Form Ties: Factory fabricated, adjustable length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
- D. Fiber Forms for Round Columns: Install forms in accordance with manufacturer's recommendations.

3.2 PLACING REINFORCEMENT:

- A. Accurately position, support and secure reinforcement against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required. Comply with ACI 301 and 318.

3.3 JOINTS:

- A. Construction Joints: Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the

Architect.

- B. Isolation Joints in Slabs-On-Grade: Construct isolation joints at all points of contact between slabs on ground and vertical surfaces and as shown on the structural drawings.
- C. Control Joints in Slabs-on-Ground: Construct control joints in slabs-on-ground to form panels of patterns as shown. See typical detail on structural drawings.
- D. Saw cuts shall be made as soon as possible after final troweling without dislodging aggregate, normally 12 hours.
- E. Expansion Joints: Provide expansion joints as shown. Install premolded filler where specified. See Section 07900 for sealants.

#### 3.4 INSTALLATION OF EMBEDDED ITEMS:

- A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.

#### 3.5 PREPARATION OF FORM SURFACES:

- A. Coat the contact surfaces of forms with a non-staining form coating compound before reinforcement is placed.

#### 3.6 CONCRETE PLACEMENT:

- A. General: Comply with ACI 304, and as herein specified. Subgrades shall be inspected and approved before concrete is placed for concrete poured on grade. Forms and reinforcing shall be inspected and approved prior to concrete placement.
- B. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suite the type of concrete and project conditions. The use of vibrators or other mechanical devices to move the concrete in the forms is not permitted. Concrete shall be deposited as near its final location as practical.
- C. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305.

#### 3.7 FINISH OF FORMED SURFACES:

- A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height chipped off, defective areas, honeycomb and tie holes filled and repaired with cement grout.
- B. Smooth Form Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete, such as waterproofing, dampproofing, painting, or other similar system, to have the as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch all defective areas including all fins, joints, concrete or mortar splatter. Projections shall be completely removed and smoothed, and

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all tie rod holes, stone pockets, wood grain marks, and holes shall be grouted flush and smoothed. All honeycomb cut out and patched with grout and smoothed.

- C. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring 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 shown.
- D. Exposed Aggregate Concrete Finish: For surfaces designated on the drawings as Detectable Warning or other areas as required by the Architect. Aggregate shall be river gravel, smooth, 1/4" minimum to 3/8" maximum size, washed, color as selected by Architect. Cement, water, admixtures, etc., per this Section (3010). Wash concrete surfaces with water and scrub with stiff bristle brush and/or wet concrete surfaces with water and scrub with acid etch solution exposing aggregate. Do not expose more than 40% of aggregate surface. Prior to performing work prepare one (1) horizontal sample panel 3'-0" x 4'-0" with full aggregate color range for review by Architect.

### 3.8 MONOLITHIC SLAB FINISHES:

- A. General: Comply with ACI 301 for the specified finish specification and methods. The use of jitterbugs for finishing slabs will not be permitted.

### 3.9 TYPE OF FINISHES AND TOLERANCES:

- A. Floated Finish: For surfaces intended to receive roofing, waterproofing membranes, or sand bed pavers. Class by tolerance (5/16" in 10'-0").
- B. Troweled Finish: For floors intended as walking surfaces or for reception of floor coverings. Class by tolerance 5/16" in 10'-0", 3/8" in 20'-) , and +/- 3/4" total building.
- C. Broom or Belt Finish: For sidewalks, steps, platforms, ramps, or other areas designated on the drawings. Class by tolerance (5/16" in 10'-0").

### 3.10 MOISTURE BARRIER:

- A. Where a moisture barrier is shown under concrete slabs on grade, install in accordance with the requirements of Section 07190.

### 3.11 CONCRETE CURING, SEALING AND PROTECTION:

- A. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
- B. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period
- C. Curing Methods: Perform curing of concrete by moisture retaining cover curing, by membrane curing, and by combination thereof, as herein specified.
- D. Provide Moisture Cover Curing as Follows:
  - 1. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing.

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- E. Provide Membrane Curing to Slabs as Follows:
  - 1. Apply membrane forming curing compound to concrete surfaces as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
- F. Curing Formed Surfaces: Cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- G. Sealing Concrete Floors: Clean surfaces of all foreign material, oil and grease. Apply an additional coat of cure and seal material, same as used concrete surfaces to all floors not receiving other finish. Apply at rate recommended by manufacturer. Do not apply second coat to floors receiving resilient flooring.

### 3.12 REMOVAL OF FORMS:

- A. Comply with ACI 301 and 318 and structural notes for removal of forms.

### 3.13 MISCELLANEOUS CONCRETE ITEMS:

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by mechanical, electrical, plumbing, or civil specialties, or other trades unless otherwise shown or directed after work of other specialties or trades is in place.
- B. Reinforced Masonry: Provide 3,000 psi concrete for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

### 3.14 CONCRETE SURFACE REPAIRS:

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar *immediately after removal of forms*.

**END OF SECTION 03010**



## CONCRETE FORMWORK

### PART 1 - GENERAL

#### 1.1 DESCRIPTION:

- A. Work specified in Section includes concrete formwork, Accessories and form coating.

#### 1.2 REFERENCES:

- A. Industry Standards:
  - 1. American Concrete Institute, ACI-301-96, Specifications for Structural Concrete for Buildings.
  - 2. American Concrete Institute, ACI-318-99, Building Code Requirements for Structural Concrete.
  - 3. American Concrete Institute, ACI-347, Recommended Practice for Concrete Formwork.
  - 4. American Concrete Institute, ACI-SP-15, Field Reference Manual.
  - 5. Southern Pine Inspection Bureau (SPIB) Grading Rules.
  - 6. Western Wood Products Association (WWPA) Grading Rules.
  - 7. American Plywood Association (APA) Grading Rules.

#### 1.3 SUBMITTALS:

- A. Manufacturer's Literature: Submit copies of manufacturer's product specifications and installation instructions for manufactured products, including form sealer and release agent.
- B. Submit list of completed projects using forming system intended to be used for this project.
- C. Shop Drawings:
  - 1. Engineered Shoring Drawings: Submit shop drawings which detail the support of concrete forms for both lateral and gravity loads in accordance with applicable codes. These drawings shall be of sufficient detail to be used by contractor for fabrication and erection. Drawing shall also indicate re-shoring required of finished structural work when used for subsequent form support. Architect's review is for general architectural applications and features only. All drawings shall be signed and sealed by a registered professional engineer.
  - 2. Formwork Line Drawings: Shop drawings shall be submitted which indicate all edge of slab locations, column locations and sizes, slab depressions, slab slopes, wall plan dimensions and elevations, and beam sizes and plan dimensions. The contractor is responsible for coordinating approved formwork line drawings with other shop drawing submittals such as reinforcing steel and structural steel. Design of formwork for structural stability and efficiency is Contractor's responsibility.

#### 1.4 QUALITY CRITERIA:

- A. Comply with the latest edition of the following codes and standards, except as noted otherwise:
  - 1. American Concrete Institute, ACI-301, Specifications for Structural Concrete for Buildings.
  - 2. American Concrete Institute, ACI-318, Building Code

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Requirements for Reinforced Concrete.

3. American Concrete Institute, ACI-347, Recommended Practice for Concrete Formwork.
4. American Concrete Institute, ACI-SP-15, Field Reference Manual.
5. Southern Pine Inspection Bureau (SPIB) Grading Rules.
6. Western Wood Products Association (WWPA) Grading Rules.
7. American Plywood Association (APA) Grading Rules.
8. American Plywood Association, APA Form V 345 Plywood for Concrete Forming.

### B. Allowable Tolerances:

1. Adhere to the following industry standards, latest edition except as otherwise indicated.
  - a. American Concrete Institute (ACI) Standards:
    - 1) ACI 301, "Specification for Structural Concrete for Buildings"
    - 2) ACI 318, "Building Code Requirements for Reinforced Concrete"
  2. Allowable Tolerances in Finished, Exposed Work:
    - a. In linear buildings lines, elevations and conspicuous lines and arises: Maximum  $\pm 3/16$ " in length of 20'-0" maximum;  $\pm 3/8$ " in length of 40'-0" or more.
    - b. In cross-sectional dimension:  $\pm 3/16$ ".
    - c. See Section 03300 CAST-IN-PLACE CONCRETE for FF and FL Requirements. Provide formwork as required to obtain the required FF and FL finish.

### C. Camber:

1. Design and install formwork and supports to produce design camber (if any) in final concrete structure to account for deflection of forms between supports under wet concrete loading, to maintain specified tolerances.

## PART 2 - PRODUCTS

### 2.1 FORMING MATERIALS:

- A. Lumber:

For work unexposed in finished project: #2 Southern Yellow Pine.
- B. Plywood:
  1. For interior exposed concrete: MDO-EXT-APA or B-B Plyform EXT-APA.
  2. For unexposed concrete: C-C EXT-APA.
- C. Metal or Plastic Forms: Smooth, undented, clean steel and new plastic forms may be used with Architect's approval, provided required texture and finish can be achieved.
- D. Earth Forms: Forms for footings may be cut into earth, provided that earth is dry, stable, level and sound.
- E. Form Ties: Breakback type with 5/8" removable vinyl sleeve of 1" diameter breakback cone type.
- F. Plywood Form Sealer: Colored polyurethane coating of type

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acceptable to plywood manufacturer, for sealing cut edges of plywood.

- G. Form Release Agent: Type as required to eliminate staining or causing surface imperfections in finishes. Use same brand form release agent for all forms.
- H. Expansion Joint Filler: Not less than 1/2 inch thick, full depth of concrete member, and in accordance with ASTM D 1751.
- I. Waterstops: Polyvinyl-chloride: unless notes as otherwise, 4" x 3/16" ribbed type.

### PART 3 - EXECUTION

#### 3.1 FORMWORK CONSTRUCTION:

- A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.
- B. Extend shoring a minimum of 3 floors under floor or roof being placed for structures over 4 stories, refer to engineered shoring drawings for specific requirements. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.
- C. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.
- D. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.
- E. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- F. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Design and construct formwork for post-tensioned structure so that post tensioning force is completely transferred to concrete. Allow for form movement such that forming does not resist post tensioning forces.
- G. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- H. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

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- I. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.  
Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- J. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set time to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- K. Layout of joints in formwork shall be in accordance with acceptable practice. Joints shall bear tightly on solid back-up.
- L. Clean forms of dirt, debris, concrete and foreign matter before each use or re-use. Examine forms prior to each re-use and replace those which developed defects affecting the strength, tightness or visual appearance.
  - 1. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
  - 2. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
  - 3. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
  - 4. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.
- M. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- N. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
- O. Re-Use of Forms:
  - 1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
  - 2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.
- P. Form Release, Cleaning and Tightening:
  - 1. Immediately prior to placement of reinforcing, apply form release agent to forms in accordance with manufacturer's instructions. Rate of application shall be constant to prevent discoloration of concrete. Remove excess material immediately.

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2. Cleaning and tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

- Q. Construct bulkheads with keys at separation of pours, except as otherwise noted on drawings.

Locations of bulkheads shall be as indicated on approved shop drawings.

### 3.2 REMOVAL OF FORMS:

- A. Contractor shall assume full responsibility for removal of formwork and forms shall be removed in such a manner as to insure complete safety of structure.
- B. Under ordinary weather conditions, wall forms and other vertical forms for concrete which do not span between definite supports may be removed after the concrete has hardened sufficiently to resist damage from removal operations.
- C. Concrete Slabs and other members which span between definite supports shall attain 70 percent of the specified 28-day strength before removal of the forms. Shores for cantilevered beams and slabs shall remain in place for at least an additional 21 days. At the Contractor's option, faster reshore removal may be determined by tests.
- D. After removing forms, horizontal members shall be promptly reshored at midspan until 28-day strength of concrete is attained. Reshores shall remain in place until concrete is at least 15 days old. No floor shall be loaded in excess of live load for which designed unless adequate shores are placed beneath members supporting the concentration of load without overloading any other portion of the structure.

**END OF SECTION 03100**



## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

##### 1.02 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2008.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- D. ASTM A 82/A 82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- E. ASTM A 185/A 185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- F. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- G. ASTM A 706/A 706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2006a.
- H. ASTM A 884/A 884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2006.
- I. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2005.
- J. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2001.
- K. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; Eighth Edition.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

##### 1.04 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
- B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

#### PART 2 PRODUCTS

## **2.01 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
  - 1. Plain billet-steel bars.
  - 2. Unfinished.
- B. Steel Welded Wire Reinforcement: ASTM A 884/A 884M, deformed, Class A epoxy coated type.
  - 1. Flat Sheets.
- C. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage (1.5 mm).
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

## **2.02 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

## **PART 3 EXECUTION**

### **3.01 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Conform to applicable code for concrete cover over reinforcement.

**END OF SECTION**

**CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, curing & testing and finishes, for the following as shown on the contract documents and as specified herein:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.
6. Building frame members.
7. Building walls.

Additionally, for high strength concrete, processing, storing, blending, mixing, special in-plant quality control, jobsite quality control, batch tickets, correct & timely dispatching coordination and consultation with representatives of testing laboratory, architect, engineer, and other authorities.

- B. Related Sections include the following:

1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Division 03 Section "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
3. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
4. Division 32 Section "Concrete Paving" for concrete pavement and walks.
5. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.
6. Division 14. Testing Laboratory Services

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.
- B. High Strength Concrete: Concrete whose specified strength ( $f_c$ ) is in excess of 6000 PSI.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete strength classification required, submit to Architect five (5) copies of mix design for concrete at least 15 days prior to delivery of concrete to project site. Contractor must review and approve mix design prior to submitting to the Architect. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Data submitted shall be as outlined in ACI chapter 5 for qualifying concrete proportions. Field strength tests shall be no older than 1 year. For high strength concrete: The concrete producer shall submit documentation (cylinder test reports, ACI 318 data with standard deviation, and coefficient of variation, etc.) of previous projects utilizing high strength concrete  $f'_c$  of 6,000 to 16,000 psi and using similar materials as would include cement, fly ash, silica fume, metakaolin, coarse and fine aggregate, high range water reducer and retarding admixtures.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement: Submit shop drawings for fabrications, bending and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams for bent bars, arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures. Shop drawings must be reviewed and marked approved by the Contractor prior to submittal to the Architect.
- D. Formwork Shop Drawings: Prepared by or under the supervision of and sealed by a qualified professional engineer detailing fabrication, assembly, and support of formwork.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
- E. Samples: For all accessories.
- F. Welding certificates.
- G. Qualification Data: For Installer & manufacturer.
- H. Material Test Reports from an independent testing lab: For the following, from a qualified testing agency, indicating compliance with requirements:
  - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
  - 2. Fly Ash.
  - 3. Silica Fume.
  - 4. Metakaolin.
- I. Material Certificates: For each of the following, signed by manufacturers and contractor certifying that each material item complies with, or exceeds, the specified requirements:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.

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4. Steel reinforcement and accessories.
  5. Fiber reinforcement.
  6. Waterstops.
  7. Curing compounds.
  8. Floor and slab treatments.
  9. Bonding agents.
  10. Adhesives.
  11. Vapor retarders.
  12. Semirigid joint filler.
  13. Joint-filler strips.
  14. Repair materials.
- J. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- K. Field quality-control test and inspection reports.
- L. Minutes of preinstallation conference.
- 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."
  2. For High Strength Concrete
    - a) The concrete producer shall submit evidence of having experience in successfully producing ready-mixed concrete with design strengths of 6,000 to 12,000 psi and produced with similar materials (H.R.W.R., silica fume, cement, sand, and rock) as may be used in the production of high strength concrete for this project.
    - b) The concrete producer shall submit documentation, including but not necessarily limited to, cylinder test reports and ACI 318 Ch. 5, Paragraph having successfully produced such high strength concrete on projects in locality of project.
- C. Testing Agency Qualifications: An independent agency, employed by the owner, 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.

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3. For high strength concrete submit evidence of successful past experience in testing high strength concrete. Provide a list of projects, clients and concrete strengths for which such testing was performed. Testing Laboratory shall be subject to inspection by the Architect/Engineer and concrete producer and shall perform sample testing of high strength concrete prior to their being accepted. The individual that samples the concrete shall be certified as an ACI concrete grade 1, field testing technician, and the one who tests the cylinders shall be certified as and ACI concrete lab technician, grade 1.
- 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. Comply with the following publications unless modified by requirements in the Contract Documents:
  1. ACI 301, Specifications for Structural Concrete, Section 1,5 &7..
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  3. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
  4. ACI 305 – Recommended Practice for Hot Weather Concreting.
  5. ACI 306 – Recommended Practice for Cold Weather Concreting.
  6. ACI 308 – Recommended Practice for Curing Concrete.
  7. ACI 309 – Recommended Practice for Consolidation of Concrete.
  8. ACI 311 – Guide for Concrete Inspection.
  9. ACI 318 – Building Code Requirements for Reinforced Concrete.
  10. Concrete Reinforcing steel institute: "Manual of Standard Practice".
- G. Concrete Testing Service: Contractor shall 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 01 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. Owner.
    - b. Architect.
    - c. Structural Engineer.
    - d. Contractor.
    - e. Appropriate Subcontractor.
    - f. Concrete Producer.
    - g. Admixture manufacturer's representative.
    - h. Testing Laboratory.
  2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

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3. Before the actual use of high strength concrete in the required location in the project, demonstrate, in a location requiring a lower strength class of concrete, that high strength concrete can be satisfactorily produced, handled, placed, and tested.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## 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 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.

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

### 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615, Grade 60 & Grade 75 deformed bars, ASTM A 767, Class I zinc coated after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 775, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.
- E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, Type 304 deformed.
- F. MFX Steel Reinforcing Bars: ASTM A1035, deformed reinforcing bars.
- G. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) ASTM A 706/A 706M, deformed bars, assembled with clips.
- H. Plain-Steel Wire: ASTM A 82, plain, cold-drawn.
- I. Deformed-Steel Wire: ASTM A 496.
- J. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.

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- K. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- L. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- M. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.
- N. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A coated, Type 1, steel.

### 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.
- D. Refer to section 033816 for additional requirements when post-tensioning is required.
- E. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- F. 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, or plastic 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.
  - 4. Concrete bricks may be used as supports only in footings and pile/pier caps.

### 2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project. Strength uniformity of cement shall be determined on the basis of ASTM C 917.
  - 1. Portland Cement: ASTM C 595, Type IP. ASTM C 150, Type I may be used only with the following:
    - a. Fly Ash: ASTM C 618, Class C or F except loss in ignition shall not exceed 4%. Fly Ash content of mix shall be between 15% and 20% of Type 1 cement by weight. Provide from one source strength uniformity of cement shall be determined on the basis of ASTM C 917, evaluation of cement strength uniformity from a single source.
  - 2. Blended Hydraulic Cement: ASTM C 595, Type IP.

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- B. Silica Fume: For non-high strength concrete: ASTM C 1240, amorphous silica.
- For High strength concrete: Microsilica is to be used at no less than 8% by weight of cement. Provide Force 10,000 by W.R. Grace Rheomac SF 100 by master builders, or Architect/Engineer accepted alternate.
- C. Metakadlin: Provide CEMX by ISG resource or Architect/Engineer accepted alternate.
- D. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Fine Aggregate – Natural quartz sand or sand manufactured from approved coarse aggregate and conforming to ASTM C33. Mixes of 6000 PSI strength or greater shall have fineness modulus not less than 2.70 and having a proven service record.
  2. Coarse Aggregate: Clean, washed, sound, crushed natural granite or limestone products. Free from clay, mud, loam, or other foreign matter. Conform to ASTM C33.
  3. Maximum Aggregate Size: Not larger than ¾", nor three-fourth of the minimum clear spacing between individual reinforcing bars or bundles of bars, except when approved otherwise by Architect. Maximum aggregate for steel-pan stair fill and thin slabs 3" thick and less, shall be 3/8". For mixes of good PSI strength or greater aggregate size shall be No. 78M (3/8 inch).
- E. Lightweight Aggregate: ASTM C 330, 3/4-inch (19-mm) nominal maximum aggregate size.
- F. Water: ASTM C 94 potable and free from deleterious amounts of acids, alkalies, salts and organic matter.

### 2.6 ADMIXTURES

General: Provide admixtures produced by acceptable manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by the Architect. For high strength concrete admixture submittals must be accompanied by documentation showing successful use in high strength concrete production. Use in strict accordance with the manufacturer's recommendations. Design of the concrete mix shall be made with the assistance of the admixture manufacturer's representative to determine dosage, addition times, and compatibility with other admixtures and mixture constituents. The admixture manufacturer's representative shall be available to assist in pretesting of the concrete and to guide initial batching procedures and jobsite usage. The admixture shall not contain any chlorides other than those attributable to the water used in manufacturing the admixture. A certificate of compliance shall be submitted to the Architect/Engineer.

- 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, Type A.
  2. Retarding Admixture: ASTM C 494, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D. (ADVA 100 by WR Grace, Glenium 2020 by Master Builders or approved alternate)

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4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F. (DARACOM 100 by WR Grace or approved alternate).(Note that ASTM C494 type F shall only be used in high strength concrete mixtures when used in conjunction with an appropriate ASTM C494 type D retarding admixture).
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
1. Products:
    - a. Boral Material Technologies, Inc.; Boral BCN.
    - b. Euclid Chemical Company (The); Eucon CIA.
    - c. Grace Construction Products, W. R. Grace & Co.; DCI.
    - d. Master Builders, Inc.; Rheocrete CNI.
    - e. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products:
    - a. Axim Concrete Technologies; Catexol 1000CI.
    - b. Boral Material Technologies, Inc.; Boral BCN2.
    - c. Cortec Corporation; MCI 2000.
    - d. Grace Construction Products, W. R. Grace & Co.; DCI-S.
    - e. Master Builders, Inc.; Rheocrete 222+.
    - f. Sika Corporation; FerroGard-901.

### 2.7 FIBER REINFORCEMENT

- A. Carbon-Steel Fiber: ASTM A 820, deformed, minimum of 2 inches long, and aspect ratio of 45 to 50.
1. Products:
    - a. Bekaert Corporation; Dramix.
    - b. Fibercon International, Inc.; Fibercon.
    - c. SI Concrete Systems; Zorex.
  2. Fiber: Type 1, cold-drawn wire.
- B. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
1. Products:
    - a. Monofilament Fibers:
      - 1) Axim Concrete Technologies; Fibrasol IIP.

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- 2) Euclid Chemical Company (The); Fiberstrand 100.
- 3) FORTA Corporation; Forta Mono.
- 4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
- 5) Metalcrete Industries; Polystrand 1000.
- 6) SI Concrete Systems; Fibermix Stealth.

b. Fibrillated Fibers:

- 1) Axim Concrete Technologies; Fibrasol F.
- 2) Euclid Chemical Company (The); Fiberstrand F.
- 3) FORTA Corporation; Forta.
- 4) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
- 5) SI Concrete Systems; Fibermesh.

2.8 CURING MATERIALS

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

1. Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edoco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
- e. Dayton Superior Corporation; Sure Film.
- f. Euclid Chemical Company (The); Eucobar.
- g. Kaufman Products, Inc.; Vapor Aid.
- h. Lambert Corporation; Lambco Skin.
- i. L&M Construction Chemicals, Inc.; E-Con.
- j. MBT Protection and Repair, Div. of ChemRex; Confilm.
- k. Meadows, W. R., Inc.; Sealtight Evapre.
- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- n. Sika Corporation, Inc.; SikaFilm.
- o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
- p. Unitex; Pro-Film.
- q. US Mix Products Company; US Spec Monofilm ER.
- r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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1. Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. Burke by Edoco; Aqua Resin Cure.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
- f. Euclid Chemical Company (The); Kurez DR VOX.
- g. Kaufman Products, Inc.; Thinfilm 420.
- h. Lambert Corporation; Aqua Kure-Clear.
- i. L&M Construction Chemicals, Inc.; L&M Cure R.
- j. Meadows, W. R., Inc.; 1100 Clear.
- k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
- l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
- m. Tamms Industries, Inc.; Horncure WB 30.
- n. Unitex; Hydro Cure 309.
- o. US Mix Products Company; US Spec Maxcure Resin Clear.
- p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products:

- a. Anti-Hydro International, Inc.; AH Clear Cure WB.
- b. Burke by Edoco; Spartan Cote WB II.
- c. ChemMasters; Safe-Cure & Seal 20.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
- e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
- f. Euclid Chemical Company (The); Aqua Cure VOX.
- g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
- h. Lambert Corporation; Glazecote Sealer-20.
- i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
- j. Meadows, W. R., Inc.; Vocomp-20.
- k. Metalcrete Industries; Metcure.
- l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
- m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- n. Tamms Industries, Inc.; Clearseal WB 150.
- o. Unitex; Hydro Seal.
- p. US Mix Products Company; US Spec Hydrasheen 15 percent
- q. Vexcon Chemicals, Inc.; Starseal 309.

- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Available Products:

- a. Burke by Edoco; Spartan Cote WB II 20 Percent.
- b. ChemMasters; Safe-Cure Clear.

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- c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.
  - d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
  - e. Euclid Chemical Company (The); Diamond Clear VOX.
  - f. Kaufman Products, Inc.; SureCure Emulsion.
  - g. Lambert Corporation; Glazecote Sealer-20.
  - h. L&M Construction Chemicals, Inc.; Dress & Seal WB.
  - i. MBT Protection and Repair, Div. of ChemRex; MasterKure-N-Seal VOC.
  - j. Meadows, W. R., Inc.; Vocomp-20.
  - k. Metalcrete Industries; Metcure 0800.
  - l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 200E.
  - m. Sonneborn, Div. of ChemRex; Kure-N-Seal.
  - n. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
  - o. Tamms Industries, Inc.; Clearseal WB STD.
  - p. Unitex; Hydro Seal 18.
  - q. US Mix Products Company; US Spec Radiance UV-25
  - r. Vexcon Chemicals, Inc.; Starseal 0800.
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products:
    - a. Burke by Edoco; Cureseal 1315.
    - b. ChemMasters; Spray-Cure & Seal Plus.
    - c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315.
    - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
    - e. Euclid Chemical Company (The); Super Diamond Clear.
    - f. Kaufman Products, Inc.; Sure Cure 25.
    - g. Lambert Corporation; UV Super Seal.
    - h. L&M Construction Chemicals, Inc.; Lumiseal Plus.
    - i. Meadows, W. R., Inc.; CS-309/30.
    - j. Metalcrete Industries; Seal N Kure 0.
    - k. Sonneborn, Div. of ChemRex; Kure-N-Seal 5.
    - l. Tamms Industries, Inc.; LusterSeal 300.
    - m. Unitex; Solvent Seal 1315.
    - n. US Mix Products Company; US Spec CS-25
    - o. Vexcon Chemicals, Inc.; Certi-Vex AC 1315
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products:
    - a. Burke by Edoco; Cureseal 1315 WB.
    - b. ChemMasters; Polyseal WB.
    - c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
    - d. Euclid Chemical Company (The); Super Diamond Clear VOX.
    - e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
    - f. Lambert Corporation; UV Safe Seal.
    - g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
    - h. Meadows, W. R., Inc.; Vocomp-30.

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- i. Metalcrete Industries; Metcure 30.
- j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
- k. Tamms Industries, Inc.; LusterSeal WB 300.
- l. Unitex; Hydro Seal 25.
- m. US Mix Products Company; US Spec Radiance UV-25.
- n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

### 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.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

### 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than [4100 psi (29 MPa)] 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 (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) 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 non-high-strength concrete as follows:
  1. Fly Ash: 25 percent.
  2. Combined Fly Ash and Pozzolan: 25 percent.
  3. Ground Granulated Blast-Furnace Slag: 50 percent.
  4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  5. Silica Fume: 10 percent.
  6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 0.15 0.30 1.00 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.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

#### 2.12 PROPORTIONING AND DESIGN OF MIXES:

- A. Prepare design mixes for each type and strength of concrete in accordance with applicable provisions of ASTM C-94. Use Ready Mixed Concrete.

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### B. Mix Proportioning:

1. Non-high strength: Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1 and ACI 318.
2. High strength: Use only mixes designed by the concrete producer and witnessed and tested by the testing laboratory.

C. Submit written reports to the Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Each mix design shall be identified by a number or code unique to that mix.

D. Design mixes to provide normal weight concrete with the 28 days psi compressive strength as indicated on drawings and schedules. High strength concrete shall develop ultimate compressive strength at 56 days equal to that noted on drawings and in this specification.

E. Admixtures: Use air entraining admixture in all exterior exposed concrete, unless otherwise indicated. Add air entraining admixture at the Manufacturer's prescribed rate to result in concrete at the point of placement having air content within the following limits: All concrete, 3% to 5% unless otherwise approved by Engineer.

F. Design slumps for high strength concrete after the addition of H.R.W.R. shall be 6 to 11 inches.

### 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, and furnish batch ticket information.

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

## PART 3 - EXECUTION

### 3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.

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2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
    1. Install keyways, reglets, recesses, and the like, for easy removal.
    2. Do not use rust-stained steel form-facing material.
  - F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
  - G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
  - H. Chamfer exterior corners and edges of permanently exposed concrete.
  - I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
  - J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
  - K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
  - L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

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

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

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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.

### 3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring. Shoring shall be designed by a registered engineer.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).
1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

### 3.6 STEEL REINFORCEMENT

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

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- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated 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 (38 mm) into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. 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. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete

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when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

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

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by 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

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that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- H. Additional Requirements for high strength concrete:
1. Ready-Mix Trucks: The operational condition and safety equipment of each truck is to be checked daily by the driver. Inspection of the mixer drum and fins is performed monthly by the fleet superintendent or plant manager. All trucks are to be certified annually for NRMCA compliance.
  2. Truck Volume: Batch mix and deliver loads that do not exceed 60% of the drum volume and a minimum of 5 cubic yards.
  3. Convey concrete from mixer to final position by pumping, taking care to prevent separation or loss of materials. Pump shall be a Schwing 3000 with a 5 inch delivery system or Architect accepted alternate.
  4. Provide sufficient labor, conveying equipment and vibrators (including portable generators) to assure continuous placements even under emergency condition (equipment breakdown; power outage).
  5. Deposit concrete in continuous operation until section being placed has been completed.
  6. Mixing time limitation: After completion of mixing, concrete shall be conveyed and placed at once; all concrete shall be placed not more than 90 minutes after introduction of mixing water. Retempering may only be by the addition of H.R.W.R. and only under the direct supervision of the concrete producer or admixture manufacturer.

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7. Max concrete temperature at placement shall be 90 Farenheit.

### 3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patached and fins and other projections exceeding ¼" in height chipped off, defective areas, honeycomb and tie holes filled and repaired with cement grout.
- B. Smooth-Formed Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete, such as waterproofing, dampproofing, painting, or other similar system, to have the as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch all defective areas including all fins, joints, concrete or mortar splatter. Projections shall be completely removed and smoothed, and all tie rod holes, stone pockets, wood grain marks, and holes shall be grouted flush and smoothed. All honeycomb cut out and patched with grout and smoothed.
- C. Exposed Aggregate Concrete Finish: For surfaces designated on the drawings as Detectable Warning or other areas as required by the Architect. Aggregate shall be river gravel, smooth, ¼" minimum to 3/8" maximum size, washed, color as selected by Architect. Cement, water, admixtures, etc., per this section (3010). Wash concrete surfaces with water and scrub with stiff bristle brush and/or wet concrete surfaces with water and scrub with acid etch solution exposing aggregate. Do not expose more than 40% of aggregate surface. Prior to performing work prepare one (1) horizontal sample panel 3'-0" x 4'-0" with full aggregate color range for review by Architect.
- D. 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.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing

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operations for concrete surfaces. Do not wet concrete surfaces.

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

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1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
  2. After broadcasting and tamping, apply float finish.
  3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
  2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
  3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

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

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m 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.

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- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Do not apply to concrete that is less than three seven 14 28 days' old.
  - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

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

### 3.15 JOINT FILLING

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

### 3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by 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 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) 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 (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired

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- areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to 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.

### 3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.

Additional inspection for high strength concrete:

- A. In addition to the requirements of Section 03010, the Architect may require inplant inspections by the testing laboratory and/or admixture manufacturer.
- B. Place concrete only under the inspection of the testing laboratory, concrete producer, special inspector, and if deemed necessary, the admixture manufacturer.
- C. Retempering: Concrete may only be rettempered by using not more than 2 the original dosage of H.R.W.R. so long as no segregation occurs. Only the producers quality control representative or the admixture's representative can rettemper the concrete.

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C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements and or as requested by Architect or Engineer:

1. Testing Frequency for High Strength Concrete: Take one sample of twelve 4 x 8" cylinders from each 25 cubic yards placed, or fractional part thereof, of each day's production, for each high strength mix design. Take samples as concrete is deposited in forms. (Concrete samples should be taken at the point of delivery. This will ensure that the samples are properly cast and cured during the critical first 48 hours). Choose random batches for sampling. Remix the sample with a shovel just enough to insure uniformity. Identify cylinders with date, sample number, and point in structure from which sample was taken.
2. Testing Frequency for Non-High Strength Concrete: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
  - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143; 1. 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. 2. For high strength concrete, one test for each set of cylinders.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample and two sets of eight cylinder specimens for high strength concrete.
  - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample and two sets of eight cylinder specimens for high strength concrete.

D. Additional Testing requirements for high strength concrete.

1. Cylinder molds: Single use molds conforming to ASTM C416. Molds shall have tightly fitting, domed lids.
2. Capping of cylinders: Unless ends of cylinders are machined, use only new high strength capping compound. Determine the strength of the compound weekly to verify its conformance with the requirements of ASTM C617. Laboratory to submit written verification that capping jigs produce cap surfaces which are perpendicular to the cylinder axis within 0.5 degrees and conform with ASTM C617 in other respects. Minimum thickness of capping plates 5/8 in. to prevent warping and resultant convexity of cap surfaces. Check capping plates and resulting caps for planeness with machinist's parallel straightedge and a 0.002in. feeler gage. Before capping visually examine top and bottom ends of cylinder and fix irregular or uneven trim or grind before capping. A maximum of 3/4" may be trimmed from each end. Measure and apply appropriate L/D factor to test load reported. Caps shall be 1/8 in. thick 1/16 inc. and at least 2 hours old at the time of test. Do not overheat the capping

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- compound or keep it hot too long. Before testing, check each cap by tapping for air voids or loss of bond. Do not reuse capping compound. Polymeric pads are permitted.
3. Compression Testing Machine: The capacity of the testing machine should be well in excess of expected total loads. Minimum capacity 400,000 lbs. Verify that the testing machine conforms to ASTM C39 in all respects, with particular regard to planeness of bearing surfaces: required sphere diameter of the spherically seated top platen: and free movement and correct centering of this top platen. Place specimens correctly in the center between the platens. The testing machine shall have a longitudinal stiffness of  $10 \times 10^6$  lb/in. and a lateral stiffness of  $10,000,000.00 \times 10^6$  lb/in. Provide calibration certificate for testing machine. Not more than 90 days prior to commencing high strength testing. Calibration devices having accuracy traceable to N.I.S.T.
    - c. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample and two sets of eight cylinder specimens for high strength concrete.
    - d. Cast and field cure two sets of two standard cylinder specimens for each composite sample and two sets of eight cylinder specimens for high strength concrete.
8. Compressive-Strength Tests: ASTM C 39
1. Non high strength concrete: test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  4. High strength concrete:
    - a. Make, store, and cure cylinders in accord with ASTM C31 and as modified herein.
    - b. Mold specimens on level rigid surface free of vibration.
    - c. Consolidate test samples by means of rodding with a standard 5/8 inch-diameter rod.
    - d. Trowel top of cylinder to flat even surface.
    - e. During initial site curing, prevent loss of moisture from specimens by covering tightly with an impervious material. Place molds in a lime saturated bath between 68 and 78° within one hour of sampling. Initial curing temperatures shall be with time/temperatures graphs.
    - f. Transfer test cylinders to laboratory curing room within 48±4 hours. Do not leave a site over weekends or holidays. Protect from disturbance during handling and transporting. Transport vertically in cushioned carrying racks. Do not allow samples to dry out during transportation.
    - g. Laboratory Curing: Strip cylinders as soon as they arrive at the laboratory. Cylinders shall be cured until testing in a thermostatically controlled fog room maintained at 95-100% R.H. and 73.4 3F. Cylinders shall be cured in saturated lime water at 73.4 3F.
    - h. Test cylinders in accord with ASTM C39. Test three cylinders at age of 3 days, (min. 72hrs.) two at age of 7 days, three at age of 28 days, three at age of 56 days and two at age of 90 days. Cylinders shall be capped with capping material in accordance with table 1 in ASTM C617, capping cylindrical concrete specimens. Polymeric pads are also allowed.
    - i. Wipe bearing surfaces clean of any debris. Align specimen centered beneath the spherical seated block. As initial load is applied, rotate the movable portion by hand so that uniform load is applied. Apply continuously and without shock, load at a rate of 20 to 50 psi per second.

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- j. Tests shall be carried to failure of the test specimen. Record mode of failure.
- k. In addition to reports required under Section 014000, immediately notify the Architect, Contractor and Concrete Producer if concrete fails to attain the early age target strengths.
- l. The concrete producer shall be added to the distribution list of all strength test reports.

9. Evaluation & Acceptance:

Non High Strength Concrete.

- 1. 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.
- 2. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- 3. 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.
- 4. 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.

High Strength Concrete

- 1. conformance: Strength level of a standard strength test shall be considered satisfactory if the following requirements are met:
  - a. The strength of 3 day specimen is 50% of the specified f'c.
  - b. The average of the 7 day specimens is 60% of the specified f'c.
  - c. The average of the 28 day specimens is 80% of the specified f'c.
  - d. The average of the 56 day specimens is 90% of the specified f'c.
- 2. Non-Conformance: Any high strength concrete that falls below f'c by more than .10 fc' shall be considered unsatisfactory and addressed by one of the following:
  - a. Replace.
  - b. Tested in accordance with ASTM C42 (Cored) and as directed by engineer. Minimum core diameter and quantity to be determined by Structural Engineer of Record.
  - c. Concrete represented by core tests shall be considered structurally adequate if the average of all cores is equal to at least 90% fc and no single core is less than 85% fc.
- 3. Concrete not considered adequate by core strength tests shall be either of the following:
  - a. Replaced.
  - b. Strength evaluation by analysis and through field investigation as directed by engineer.
  - c. Testing, engineering services, structural modifications, and replacements of any concrete not meeting any of the above requirements shall be at the Contractor's expense.

10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete

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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.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.  
Remove and replace defective concrete at discretion of Architect; adequately strengthen and resurface in a manner acceptable to Architect at no additional cost. Architect's and Engineer's cost of modification, analysis, etc. is to be borne by the contractor.

### E. Defective Concrete

1. Remove and replace defective concrete at discretion of Architect; adequately strengthen and resurface in a manner acceptable to Architect at no additional cost. Architect's and Engineer's cost of modification, analysis, etc. is to be borne by the contractor.

**END OF SECTION 03300**

## SECTION 03390

### CONCRETE CURING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Initial and final curing of horizontal and vertical concrete surfaces.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03300 (03 3000) - Cast-in-Place Concrete.

##### 1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007) .
- C. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
- D. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.

##### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1R.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver curing materials in manufacturer's sealed packaging, including application instructions.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Membrane Curing Compound: ASTM C 309 Type 1 - Clear or translucent, Class B.
  - 1. Acrylic type.
- B. Water: Potable, not detrimental to concrete.

#### PART 3 EXECUTION

##### 3.01 EXECUTION - HORIZONTAL SURFACES

- A. Cure floor surfaces in accordance with ACI 308R.
- B. Cure floor surfaces in accordance with ACI 308 and meet the finished flooring manufacturers' requirements.
- C. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions in two coats, with second coat applied at right angles to first.

##### 3.02 EXECUTION - VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308R.
- B. Cure surfaces in accordance with ACI 308.
- C. Membrane Curing Compound: Apply compound in accordance with manufacturer's instructions in two coats, with second coat applied at right angles to first.

**3.03 PROTECTION**

- A. Do not permit traffic over unprotected floor surface.

**END OF SECTION**

## SECTION 03451

### ARCHITECTURAL PRECAST CONCRETE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Architectural precast concrete wall caps and sills.;
- B. Architectural precast concrete pavers, paver pedestals, and planters.
- C. Intermediate and perimeter joint seals.
- D. Grouting under panels.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03200 - Concrete Reinforcement.
- B. Section 03300 - Cast-in-Place Concrete: Admixtures.
- C. Section 07620 - Sheet Metal Flashing and Trim: Reglets recessed in units.
- D. Section 07900 - Joint Sealers: Perimeter joints with sealant and backing.

##### 1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2008.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.
- D. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; Precast/Prestressed Concrete Institute; 2005.
- E. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; Sixth Edition, 2004.
- F. PCI MNL-122 - Architectural Precast Concrete; Precast/Prestressed Concrete Institute; 2007, Third Edition.
- G. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; 1988, Second Edition.
- H. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; Precast/Prestressed Concrete Institute; 2000.

##### 1.04 DESIGN REQUIREMENTS

- A. Design units to withstand design loads and erection forces. Calculate structural properties of units in accordance with ACI 318.
- B. Design units to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

##### 1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.

- B. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials.
  - 1. Include details of mix designs.
  - 2. Include structural design calculations.
- C. Samples: Submit two, 6x6 inch (152x152 mm) in size, illustrating surface finish, color and texture.
- D. Fabricator qualifications.

#### **1.06 QUALITY ASSURANCE**

- A. Perform the work of this section in accordance with PCI MNL-117, PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318. Perform welding in accordance with AWS D1.1.
- B. Fabricator Qualifications:
  - 1. Firm having at least 2 years of documented experience in production of precast concrete of the type required.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Handling: Lift and support precast units only from support points.
- B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.
- C. Protect units to prevent staining, chipping, or spalling of concrete.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Architectural Precast Concrete:
  - 1. Any manufacturer holding a PCI Group A Plant Certification for the types of products specified; see [www.pci.org](http://www.pci.org).
  - 2. Substitutions: See Section 01600 - Product Requirements.

#### **2.02 PRECAST UNITS**

- A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.
  - 1. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
  - 2. Calculate structural properties of units in accordance with ACI 318.
  - 3. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
  - 4. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

#### **2.03 REINFORCEMENT**

- A. Comply with requirements of Section 03200.

#### **2.04 CONCRETE MATERIALS**

#### **2.05 MIX**

- A. Concrete: Minimum 5000 psi (34 MPa), 28 day strength, air entrained to 5 to 7 percent in accordance with ACI 301.

## **2.06 FABRICATION**

- A. Fabricate in conformance with PCI MNL-117 and PCI MNL-135.
- B. Place recessed flashing reglets continuous and straight.
- C. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

## **2.07 FINISH - PRECAST UNITS**

- A. Finish Type A: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

## **2.08 FINISH - SUPPORT DEVICES**

- A. Clean surfaces of rust, scale, grease, and foreign matter.

## **2.09 FABRICATION TOLERANCES**

- A. Conform to PCI MNL-117 and PCI MNL-135.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

### **3.02 ERECTION**

- A. Erect units without damage to shape or finish. Replace or repair damaged panels.
- B. Erect units level and plumb within allowable tolerances.

### **3.03 TOLERANCES**

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-135, except as specifically amended below.

**END OF SECTION**



## SECTION 04065

### MORTAR AND MASONRY GROUT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

##### 1.02 RELATED REQUIREMENTS

- A. Section 04811 (04 2002) - Single-Wythe Unit Masonry: Installation of mortar and grout.
- B. Section 04815 (04 2723) - Cavity Walls: Installation of mortar and grout.
- C. Section 04852 (04 4301) - Stone Masonry Veneer: Installation of mortar.
- D. Section 08110 (08 1113) - Steel Doors and Frames: Products and execution for grouting steel door frames installed in masonry.
- E. Section 02640 (33 0513) - Manholes and Covers: Installation of mortar and grout.

##### 1.03 REFERENCE STANDARDS

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements For Masonry Structures; American Concrete Institute International; 2008.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM C 5 - Standard Specification for Quicklime for Structural Purposes; 2003.
- D. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2007.
- E. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
- F. ASTM C 150 - Standard Specification for Portland Cement; 2007.
- G. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006.
- H. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007a.
- I. ASTM C 387/C 387M - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete; 2009.
- J. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2007.
- K. ASTM C 476 - Standard Specification for Grout for Masonry; 2008.
- L. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2008a.
- M. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete; 2005.
- N. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout; 2008.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations.

- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C 270 and test and evaluation reports per ASTM C 780.
- E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C 476 and test and evaluation reports to requirements of ASTM C 1019.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Instructions: Submit packaged dry mortar manufacturer's installation instructions.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

#### **1.07 FIELD CONDITIONS**

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Portland Cement: ASTM C 150, Type I - Normal; color as required to produce approved color sample.
- B. Packaged Dry Mortar: ASTM C 387/C 387M, Type N, using gray color cement.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Quicklime: ASTM C 5, non-hydraulic type.
- E. Mortar Aggregate: ASTM C 144.
- F. Grout Aggregate: ASTM C 404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C 979.
  - 1. Color(s): To be selected from Manufactures full range of colors.
  - 2. Manufacturers:
    - a. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - b. Solomon Colors: [www.solomoncolors.com](http://www.solomoncolors.com).
    - c. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- H. Water: Clean and potable.

#### **2.02 MORTAR MIXES**

- A. Mortar for Unit Masonry: ASTM C 270, Property Specification.
  - 1. Exterior, non-loadbearing masonry: Type N.
  - 2. Interior, non-loadbearing masonry: Type O.

- B. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.
- C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

### **2.03 MORTAR MIXING**

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, re-temper only within two hours of mixing.

### **2.04 GROUT MIXING**

- A. Mix grout in accordance with ASTM C 94/C 94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

### **2.05 PRECONSTRUCTION TESTING**

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01400 (01 4000).

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

### **3.02 INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Do not displace reinforcement while placing grout.
- C. Remove excess mortar from grout spaces.

### **3.03 GROUTING**

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.

**END OF SECTION**



## SECTION 04810

### UNIT MASONRY ASSEMBLIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete Block.
- B. Reinforcement and Anchorage.
- C. Accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03200 (03 2000) - Concrete Reinforcement: Reinforcing steel for grouted masonry.
- B. Section 04065 (04 0511) - Mortar and Masonry Grout.
- C. Section 07620 (07 6200) - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- D. Section 07900 (07 9005) - Joint Sealers: Backing rod and sealant at control and expansion joints.

##### 1.03 REFERENCE STANDARDS

- A. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- B. ASTM A 82/A 82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- D. ASTM A 641/A 641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009.
- E. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units; 2006b.
- F. ASTM C 91 - Standard Specification for Masonry Cement; 2005.
- G. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2006.
- H. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007a.
- I. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2007.
- J. ASTM C 476 - Standard Specification for Grout for Masonry; 2008.
- K. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete; 2005.
- L. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2006.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

##### 1.05 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four samples of pre-finished concrete masonry units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

#### **1.07 MOCK-UP**

- A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar and accessories and structural backup in mock-up.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store pre-faced concrete block units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

### **PART 2 PRODUCTS**

#### **2.01 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm) and nominal depth of 8 inches (200 mm).
  - 2. Load-Bearing Units: ASTM C 90, normal weight.
    - a. Hollow block, as indicated.
    - b. Exposed faces: Manufacturer's standard color and texture where indicated.
  - 3. Non-Loadbearing Units: ASTM C 129.
    - a. Hollow block, as indicated.
    - b. Normal weight.

#### **2.02 MORTAR AND GROUT MATERIALS**

- A. Mortar and grout: As specified in Section 04065 (04 0511).
- B. Grout Aggregate: ASTM C 404.

#### **2.03 REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers of Joint Reinforcement and Anchors:
  - 1. Dur-O-Wal: [www.dur-o-wal.com](http://www.dur-o-wal.com).
  - 2. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.

- B. Single Wythe Joint Reinforcement: Truss type; ASTM A 82/A 82M steel wire, mill galvanized to ASTM A 641/A 641M, Class 3; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.

## **2.04 FLASHINGS**

- A. Metal Flashing Materials: Aluminum, as specified in Section 07620 (07 6200).
- B. Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet; 0.030 inch (0.75 mm) total thickness; with cross-linked polyethylene top and bottom surfaces.

## **2.05 ACCESSORIES**

- A. Building Paper: ASTM D 226, Type I ("No.15") asphalt felt.
- B. Weeps: Molded PVC grilles, insect resistant.
- C. Cavity Vents: Polyester mesh.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### **3.02 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

### **3.03 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

### **3.04 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: As indicated for different locations.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
  - 3. Mortar Joints: Concave.

### **3.05 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners.

- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### **3.06 WEEPS/CAVITY VENTS**

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches (800 mm) on center horizontally below shelf angles and lintels, and near top of walls.

### **3.07 CAVITY MORTAR CONTROL**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### **3.08 REINFORCEMENT AND ANCHORAGE - GENERAL**

#### **3.09 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  1. Extend flashings full width at such interruptions and at least 4 inches (100 mm) into adjacent masonry or turn up at least 4 inches (100 mm) to form watertight pan at non-masonry construction.
  2. Remove or cover protrusions or sharp edges that could puncture flashings.
  3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.
- C. Extend plastic, laminated, and EPDM flashings to within 1/4 inch (6 mm) of exterior face of masonry.
- D. Lap end joints of flashings at least 4 inches (100 mm) and seal watertight with mastic or elastic sealant.

#### **3.10 LINTELS**

- A. Install loose steel lintels over openings.

#### **3.11 CONTROL AND EXPANSION JOINTS**

- A. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- B. Size control joint in accordance with Section 07900 (07 9005) for sealant performance.

### **3.12 BUILT-IN WORK**

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### **3.13 TOLERANCES**

- A. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft (3 mm/m).
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

### **3.14 CUTTING AND FITTING**

- A. Cut and fit for pipes and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.15 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### **3.16 PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION**



## SECTION 04811

### SINGLE-WYTHE UNIT MASONRY

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete masonry units.
- B. Reinforcement, anchorage, and accessories.
- C. Flashings.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03200 - Concrete Reinforcement: Reinforcing steel for grouted masonry.
- B. Section 04065 - Mortar and Masonry Grout: Mortar and grout for single wythe unit masonry.
- C. Section 07620 - Sheet Metal Flashing and Trim: Cap flashings over masonry work.
- D. Section 07900 - Joint Sealers: Rod and sealant at control joints.

##### 1.03 REFERENCE STANDARDS

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2008.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM A 82/A 82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- D. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- E. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units; 2006b.
- F. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2006.
- G. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2006.
- H. IMIABC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- I. IMIABC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for pre-faced and concrete masonry units and fabricated wire reinforcement.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

##### 1.05 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

## **1.07 FIELD CONDITIONS**

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

## **PART 2 PRODUCTS**

### **2.01 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
  1. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm) and nominal depths as indicated on the drawings for specific locations.
  2. Load-Bearing Units: ASTM C 90, normal weight.
    - a. Hollow block.
  3. Non-Loadbearing Units: ASTM C 129.
    - a. Hollow block.
    - b. Medium weight.

### **2.02 MORTAR AND GROUT MATERIALS**

- A. Mortar and Grout: As specified in Section 04065.

### **2.03 REINFORCEMENT AND ANCHORAGE**

- A. Single Wythe Joint Reinforcement: Truss type; ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.

### **2.04 FLASHINGS**

- A. Metal Flashing Materials: Aluminum, as specified in Section 07620.
- B. Rubberized Asphalt Flashing: Self-adhering composite material comprising rubberized asphalt adhesive compound bonded to cross-laminated polyethylene film, minimum 0.030 inch (0.75 mm) total thickness.
- C. Lap Sealant: Butyl type as specified in Section 07900.

### **2.05 ACCESSORIES**

- A. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.
- B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### **3.02 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

### **3.03 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 16 inches (406 mm).
  - 3. Mortar Joints: Concave.

### **3.04 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Remove excess mortar as work progresses.
- D. Interlock intersections and external corners, except for units laid in stack bond.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

### **3.05 REINFORCEMENT AND ANCHORAGE**

- A. Install horizontal joint reinforcement 16 inches (400 mm) on center.

### **3.06 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 4 inches (100 mm) into adjacent masonry or turn up at least 4 inches (100 mm) to form watertight pan at non-masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend plastic and laminated flashings to within 1/4 inch (6 mm) of exterior face of masonry.
- C. Lap end joints of flashings at least 4 inches (100 mm) and seal watertight with mastic or elastic sealant.

### **3.07 LINTELS**

- A. Install loose steel lintels over openings.
- B. Maintain minimum 8 inch (203 mm) bearing on each side of opening.

### **3.08 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control and expansion joints.

### **3.09 BUILT-IN WORK**

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

- C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### **3.10 TOLERANCES**

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft (3 mm/m).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

### **3.11 CUTTING AND FITTING**

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.12 CLEANING**

- A. Remove excess mortar and mortar smears as work progresses.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

### **3.13 PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION**

## **SECTION 04851**

### **CUT STONE VENEER**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Cut sandstone veneer at exterior walls.
- B. Metal anchors and supports.
- C. Joint sealing and Joint pointing.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 07620 (07 6200) - Sheet Metal Flashing and Trim: Flashings at copings.
- B. Section 07900 (07 9005) - Joint Sealers: Sealant for panel joints.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.
- B. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007a.
- C. ASTM C 616 - Standard Specification for Quartz-Based Dimension Stone; 2003.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week before starting work of this section.

##### **1.05 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Samples: Submit two stone samples 12 x 12 inch (304x304 mm) in size, illustrating color range and texture, markings, surface finish.
- C. Samples: Submit mortar color samples.

##### **1.06 QUALITY ASSURANCE**

- A. Stone Fabricator: Company specializing in fabricating cut stone with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

##### **1.07 MOCK-UP**

- A. Construct stone wall mock-up, 4' long by 4' wide, including stone anchor accessories, sill and head flashings, window frame, corner condition, typical control joint.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

##### **1.08 FIELD CONDITIONS**

- A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

#### **PART 2 PRODUCTS**

## **2.01 STONE**

- A. Sandstone; complying with ASTM C616, Classification I - Sandstone.
  - 1. Color: red.
  - 2. Surface Texture: Natural.
  - 3. Acceptable Producers:
    - a. Design Materials, Inc.; Product India - Red Sandstone. 303.256.2800
    - b. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.02 MORTAR**

- A. Mortar: ASTM C270, Type N, Proportion specification, using Portland cement of white color.
- B. Mortar Color Additive: Mineral oxide pigment of to match color of stone.

## **2.03 ANCHORS AND ACCESSORIES**

- A. Anchors and Other Components in Contact with Stone: Stainless steel, ASTM A 666, Type 304.
  - 1. Sizes and configurations: As required for vertical and horizontal support of stone and applicable loads.
  - 2. Wire ties are not permitted.
- B. Support Components not in Contact with Stone: Stainless steel, ASTM A167, Type 304.
- C. Setting Buttons and Shims: Lead type.
- D. Flashings:.
- E. Sealant: type specified in Section 07900 (07 9005); color as selected.
- F. Back Coating: Cementitious parging of mortar to a minimum thickness of 1/2" inch (12.7 mm).
- G. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

## **2.04 STONE FABRICATION**

- A. Thickness: 1 1/2 inch (38 mm).
- B. Fabricate units for uniform coloration between adjacent units and over the full area of the installation.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that support work and site conditions are ready to receive work of this section.
- B. Verify that items built-in under other sections are properly located and sized.

### **3.02 PREPARATION**

- A. Clean stone prior to erection. Do not use wire brushes or implements that will mark or damage exposed surfaces.
- B. Coat back surfaces with back coating. Allow coating to cure.

### **3.03 INSTALLATION**

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joint minimum 6 inches (150 mm) and seal watertight.
- B. Set stone with a consistent joint width of 3/8 inch (9 mm).
- C. Install anchors and place setting buttons to support stone and to establish joint dimensions.

- D. Fill joints with pointing mortar. Pack and work into voids. Neatly tool surface to concave joint.
- E. Seal joints indicated with sealant. Perform sealant work in accordance with requirements of Section 07900 (07 9005).

### **3.04 TOLERANCES**

- A. Positioning of Elements: Maximum 1/4 inch (6 mm) from true position.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 50 feet (13 mm in 15 m).
- C. Maximum Variation Between Face Plane of Adjacent Panels: 1/16 inch (1.5 mm).
- D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in any two stories.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm/m); 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch (13 mm) maximum.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet (3 mm/m).

### **3.05 CUTTING AND FITTING**

- A. Obtain approval prior to cutting or fitting any item not so indicated on Drawings.
- B. Do not impair appearance or strength of stone work by cutting.

### **3.06 CLEANING**

- A. Remove excess mortar and sealant upon completion of work.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

**END OF SECTION**



## STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Sections include the following:
  - 1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
  - 3. Division 9 painting Sections for surface preparation and priming requirements.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4
  - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

#### 1.5 SUBMITTALS

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

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- B. Shop Drawings: Show fabrication of structural-steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment drawings.
  - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  - 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation registered in the state of the project.
- C. Welding certificates.
- D. Qualification Data: For fabricator.
- E. Mill 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. Direct-tension indicators.
  - 4. Tension-control, high-strength bolt-nut-washer assemblies.
  - 5. Nonshrink grout.
- F. Source quality-control test reports.

### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
  - 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
  - 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
  - 5. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
  - 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

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1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

### 1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, : ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  1. Weight Class: Standard.
  2. Finish: Black, except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; hardened carbon-steel washers.
  1. Finish: Plain .
  2. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B
    - a. Finish: Plain.
  3. Finish: Plain.
  4. Welded Stud: ASTM A 108 Grade 1015 or 1020 [headed] [type as required for intended use]. [Head dimensions for shear connectors as required by ANSI/AWS D1.1].
- B. Unheaded Anchor Rods: ASTM F 1554, Grade 36, weldable.
  1. Configuration: Straight.
  2. Nuts: ASTM A 563 heavy hex carbon steel.

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3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Plain.

### 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: ASTM A 780.

### 2.4 GROUT

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

### 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
  1. Camber structural-steel members where indicated.
  2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
  3. Mark and match-mark materials for field assembly.
  4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
  1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
  2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts 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.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces to receive sprayed fire-resistive materials.
  - 4. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

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1. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

### 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
  1. Fill vent holes and grind smooth after galvanizing.
  2. Galvanize lintels attached to structural-steel frame and located in exterior walls. All expose structural steel members.

### 2.9 SOURCE QUALITY CONTROL

- A. General Contractor will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
  1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
  1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
  1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
  2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base plates. Clean bottom surface of base plates.
  - 1. Set base plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of base plate.
  - 3. Snug-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 base or bearing plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and base or bearing 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.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection unless approved by Architect. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

## 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts 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.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design " for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

## 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: General Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
  - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
    - a. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - b. Ultrasonic Inspection: ASTM E 164.
    - c. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
  - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

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3.6 REPAIRS 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 installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, and abutting structural steel.
  - 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. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

**END OF SECTION 05120**



## SECTION 05400

### COLD FORMED METAL FRAMING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Formed steel stud interior wall framing.

##### 1.02 REFERENCE STANDARDS

- A. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- B. ASTM C 955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2007.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- D. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

##### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
  - 1. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  - 2. The Steel Network, Inc: [www.SteelNetwork.com](http://www.SteelNetwork.com).
  - 3. Substitutions: See Section 01600 - Product Requirements.

##### 2.02 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

##### 2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C 955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
  - 1. Gage and depth: As required to meet specified performance levels.

## **2.04 ACCESSORIES**

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## **2.05 FASTENERS**

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A 153/A 153M.
- B. Anchorage Devices: Power actuated.
- C. Welding: In conformance with AWS D1.1.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF STUDS**

- A. Install components in accordance with manufacturers' instructions and ASTM C 1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches (600 mm) on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- D. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- E. Install intermediate studs above and below openings to align with wall stud spacing.
- F. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- G. Attach cross studs to studs for attachment of fixtures anchored to walls.
- H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- I. Touch-up field welds and damaged galvanized surfaces with primer.

### **3.02 WALL SHEATHING**

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

### **3.03 TOLERANCES**

- A. Maximum Variation from True Position: 1/4 inch (6.35 mm).
- B. Maximum Variation of any Member from Plane: 1/8 inch (3.18 mm).

**END OF SECTION**

## SECTION 05500

### METAL FABRICATIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Shop fabricated steel items.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2002.
- B. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- C. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- D. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- E. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- F. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2003 (Reapproved 2007).
- G. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2009.
- H. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.
- I. ASTM A 500/A 500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2007.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- L. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- N. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Plates: ASTM A 283.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- E. Fasteners: \_\_\_\_\_.
- F. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

### **2.02 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

### **2.03 FABRICATED ITEMS**

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
  - 1. Side Rails: 3/8 x 2 inches (9 x 50 mm) members spaced at 20 inches (500 mm).
  - 2. Rungs: 2 1/4"x3/4 inch (57.15 x 19.05 mm) channel tread spaced 12 inches (300 mm) on center.
  - 3. Space rungs 7 inches (175 mm) from wall surface.
- B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- C. Lintels: As detailed; prime paint finish.

### **2.04 FINISHES - STEEL**

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.
- D. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A 123/A 123M requirements.
- E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A 123/A 123M requirements.

## **2.05 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

### **3.03 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

**END OF SECTION**

## SECTION 05510

### METAL STAIRS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Stairs with metal treads.
- B. Structural steel stair framing and supports.
- C. Handrails and guards.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- B. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- D. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2009.
- E. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.
- F. ASTM A 500/A 500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- G. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2007.
- H. ASTM A 786/A 786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2005.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2007.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- K. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- L. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates.

## 1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

## PART 2 PRODUCTS

### 2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
  - 1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
  - 2. Dimensions: As indicated on drawings.
  - 3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
  - 4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
  - 5. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
  - 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
    - a. Welded Joints: Continuously welded and ground smooth and flush.
    - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
    - c. Exposed Edges and Corners: Eased to small uniform radius.
    - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

### 2.02 METAL STAIRS WITH METAL TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Perforated grated.
  - 1. Tread Thickness: 1/4 inch (6 mm), minimum.
  - 2. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.
- D. Risers: Steel sheet.
  - 1. Riser Thickness: As required by design; 14 gage, 0.075 inch (1.9 mm) minimum.
  - 2. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
- E. Stringers: Rolled steel channels.
  - 1. Stringer Depth: As indicated on drawings.
  - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Railings: Steel picket railings.
- H. Finish: Shop- or factory-prime painted.

## **2.03 HANDRAILS AND GUARDS**

- A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
  - 1. Outside Diameter: 1-1/4 inch (32 mm), minimum, to 1-1/2 inches (38 mm), maximum.
- B. Guards:
  - 1. Top Rails: Round pipe or tube rails unless otherwise indicated.
    - a. Outside Diameter: 1-1/4 inch (31 mm), minimum, to 1-1/2 inches (38 mm), maximum.
  - 2. Infill at Picket Railings: Vertical pickets.
    - a. Horizontal Spacing: Maximum 4 inches (100 mm) on center.
    - b. Material: Solid steel bar.
    - c. Shape: Square.
    - d. Size: 1" inch (25.4 mm) square.
    - e. Top Mounting: Welded to underside of top rail.
    - f. Bottom Mounting: As indicated on drawings.
  - 3. End and Intermediate Posts: Same material and size as top rails.
    - a. Horizontal Spacing: As indicated on drawings.
    - b. Mounting: Welded to top surface of stringer.

## **2.04 MATERIALS**

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 or ASTM A 501 structural tubing, round and shapes as indicated.
- C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Steel Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- E. Welding Materials: AWS D1.1; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

## **2.05 SHOP FINISHING**

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
  - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
  - 2. Number of Coats: One.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.02 PREPARATION**

- A. When field welding is required, clean and strip primed steel items to bare metal.

### **3.03 INSTALLATION**

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

#### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

**END OF SECTION**

## SECTION 05520

### HANDRAILS AND RAILINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps.
- D. Balcony railings and guardrails.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- B. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

#### PART 2 PRODUCTS

##### 2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs (333 N) at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

##### 2.02 STEEL RAILING SYSTEM

- A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

##### 2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
2. Interior Components: Continuously seal joined pieces by continuous welds.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

#### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

**END OF SECTION**

## SECTION 05531

### GRATINGS AND FLOOR PLATES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Formed metal floor, mezzanine, and stair tread gratings.
- B. Flat surface floor and stair tread plating.
- C. Perimeter closure.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05510 - Metal Stairs: Framing for grating and stair treads.
- B. Section 09900 - Paints and Coatings: Field paint finish.

##### 1.03 REFERENCE STANDARDS

- A. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- B. ASTM A 786/A 786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2005.
- C. NAAMM MBG 531 - Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers; 2009 (ANSI/NAAMM MBG 531).
- D. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for loading requirements.

##### 1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Steel Floor Plate: ASTM A 786/A 786M; pattern as indicated.

##### 2.02 ACCESSORIES

- A. Fasteners and Saddle Clips: Galvanized steel:
- B. Perimeter Closure: Of same material as grating.

##### 2.03 FABRICATION

- A. Grating Type: NAAMM MBG 531, Pressure Locked Type.

##### 2.04 FINISHES

- A. Prepare surfaces to be primed in accordance with SSPC-SP 2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Do not prime surfaces in direct contact with concrete or where field welding is required.

- D. Prime paint items with one coat.
- E. Galvanizing for Steel Hardware: ASTM A 153/A 153M.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Verify that supports are correctly positioned.

#### **3.02 INSTALLATION**

- A. Install components in accordance with manufacturer's instructions.

**END OF SECTION**



**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Structural floor, wall, and roof framing.
- B. Built-up structural beams and columns.
- C. Wood nailers and curbs for roofing and items installed on roof.
- D. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, and wood trim.

**1.2 REFERENCES**

- A. AFPA/AWC –National Design Specification for Wood Construction; American Forest and Paper Association; 2002.
- B. AWWA - Use Category System (UCS); 2003.
- C. APA/NIST PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.
- D. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 1999.
- E. ANSI/TPI 1-2002 – National Design Standard for Metal Plate Connected Wood Truss Construction; American National Standards Institute; 2002.
- F. WCLIB (GR) - Standard Grading Rules #17; West Coast Lumber Inspection Bureau; 2000. (for all Hem-Fir lumber)
- G. NLGA (GR) – Standard Grading Rules for Canadian Lumber; National Lumber Grades Authority; 2005. (for all Spruce-Pine-Fir lumber)
- H. SPIB (GR) – Standard Grading Rules for Southern Pine Lumber; Southern Pine Inspection Bureau; 2002. (for all Mixed Southern Pine lumber)

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Submittal Requirements specified in Section 01 - General Requirements.
- B. Product data for the following products:
  - 1. Engineered wood products.
  - 2. Underlayment.
  - 3. Insulating sheathing.

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- 4. Construction adhesives.
  - C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of review of American Lumber Standards Committee.
  - D. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
    - 1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
    - 2. For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.
    - 3. For fire-retardant-treated wood products include certification by treating plant that treated material complied with specified standard and other requirements.
    - 4. Warranty of chemical treatment manufacturer for each type of treatment.
  - E. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
    - 1. Engineered wood products.
    - 2. Metal framing anchors.
- 1.4 QUALITY ASSURANCE
- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
  - B. Protect site fabricated trusses from warping or other distortion by stacking in vertical position, braced to resist movement.

### PART 2 - PRODUCTS

#### 2.1 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: per species indicated, see section 1.2.
- B. Sizes: Nominal sizes as indicated on drawings.
- C. Moisture Content: S-dry or KD19.
- D. Stud Framing (2 x 2 through 2 x 6), provide one of the following:
  - 1. Species: Southern Yellow Pine, grade No. 2
- E. Wall top and bottom plates (runners):

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1. Species: Southern Yellow Pine, grade No. 2
- F. Posts and Beams Framing (2 x 6 through 6 x 24):
  1. Species: as specified on construction documents.
- G. Miscellaneous Blocking, Furring, and Nailers:
  1. Species: Mixed Southern Pine, grade No. 3.
  2. Species: Hem-Fir, grade No. 3.
  3. DensGlass Gold Exterior Sheathing or approved equal.

### 2.2 ACCESSORIES

- A. Fasteners and Anchors:
  1. Fasteners: Hot-dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
- B. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- C. Subfloor Glue: Waterproof, water base, air cure type, cartridge dispensed.
- D. Building Paper: #15, nonperforated, asphalt saturated felt complying with ASTM D 226, Type 1.

### 2.3 FACTORY WOOD TREATMENT

- A. Pressure Treatment of Lumber in Contact with Concrete or Masonry: AWPA Use Category UC2: 0.25 ACQ/0.20 CBA/0.10 CA-B. Also as indicated in Contract Drawings.

### 2.4 CONNECTORS

- A. Typical Member to Member Connections:
  1. Wood to wood framed connections shall to be made with bolts and/or joist hangers. Toe-nailing is not permitted.
  2. Connections: Triple dipped galvanized;
    - a. Manufacturer: Simpson Strong-Tie Co., Inc., SEMCO (KantSag) or approved equal
    - b. Provide additional miscellaneous connectors of type required for specific installation.
  3. Floors:
    - a. Install wood bridging at floor joists at span quarter points.
    - b. Use joist hangers appropriate for each condition.
  4. See Structural Drawings for details.

### 2.5 BUILDING WRAP

- A. Air retarder complying with ASTM E 1677, equal to FirstWrap Weather Barrier manufactured by Firstline Corporation: made from polyolefin; either cross laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:
  1. Minimum thickness; 17 mils

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2. Minimum water-vapor transmission: 10 perms (575 ng/Pa x s x sq. M) when tested according to ASTM E 96, Procedure A
  3. Maximum flame spread: 25 per ASTM E 84
  4. Minimum allowable exposure time: 3 months.
- B. Seaming Tape: 3-inch wide lap seaming tape equal to FirstWrap WideTrack manufactured by Firstline Corporation.
- C. Acceptable Manufacturers:
1. Amoco Foam Products
  2. DuPont Company, Fibers Department
  3. Celotex Corp., Building Products Div.
  4. Firstline Corporation

### PART 3 - EXECUTION

#### 3.1 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Coordinate installation of wood structure with steel structural members.
- D. Install structural wood members full length without splices unless otherwise specifically detailed.
- E. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA WCD 1 T11.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.
- H. Frame openings with two or more studs at each jamb; support headers on cripple studs.
- I. Provide miscellaneous members as indicated or as required to support finishes, fixtures, specialty items, and trim.

#### 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut

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as required for true line and level of work to be attached. Coordinate location with other work involved.

- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

### 3.3 WOOD FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.
- B. Verify condition of existing framing when exposed. Provide shims and furring to align with new finished wall surfaces.

### 3.4 WOOD FRAMING, GENERAL

- A. Comply with NFPA "Manual for Wood Frame Construction," unless otherwise indicated.
  - 1. Install double studs at openings and minimum triple studs at beam bearing unless indicated otherwise on the Drawings
    - a. All bearing stud walls shall have solid blocking at max 4'-0" o.c.
    - b. Install double top plates and pressure treated sill plates at ground level.
    - c. Headers shall be two 2 x 10 members with 1/2 inch plywood spacers unless noted otherwise.
    - d. Provide 2 x 4 wood framing at 16" o.c. at drop ceilings. Brace to structure above.
- B. Install framing composed of engineered wood products to comply with manufacturer's directions.
- C. Install framing members of size and spacing indicated.
- D. Anchor and nail to comply with the nailing schedule shown on the Structural Drawings.
- E. Do not splice structural members between supports.
- F. Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2 inch thick lumber of the same width as framing members.
- G. Provide preservative treated wood at bearing on concrete.

### 3.5 STUD FRAMING

- A. Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Install single bottom plate and double top plates using 2 inch thick members whose widths equal that of studs; except single top plate

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may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.

1. For exterior walls, install wood studs spaced 16 inches o.c. unless otherwise noted. Refer the drawings.
  2. For interior partitions and walls install 2 x 4 inch wood studs spaced 24 inches o.c. unless otherwise noted. Refer the drawings.
  3. Provide all bearing walls with blocking at max 4'-0" o.c.
- B. Construct corners and intersections with minimum 3 studs. Install miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items, and trim.
- C. Frame openings with multiple studs and headers. Install nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.
1. For nonbearing partitions, install double-jamb studs and headers not less than 4 inch deep for openings 36 inches and less in width, and not less than 6 inches deep for wider openings.
  2. For load-bearing partitions, install double-jamb studs for openings 72 inches and less in width, and triple-jamb studs for wider openings. Install headers of depth shown, or if not shown, as recommended by NFPA "Manual for House Framing."

### 3.6 FLOOR JOIST (TRUSSES) FRAMING

- A. Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inch of bearing on wood and as recommended by joist manufacturer.
1. Refer section 06170
- B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.
- C. Lap members framing from opposite sides of beams, girders or partitions not less than 4 inches or securely tie opposing members together. Install solid blocking (2 inches thick by depth of joist) over supports.
- D. Install bridging as noted on structural documents.
- E. Submit Floor Joist layouts and details for approval.

### 3.7 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Place sill gasket directly on sill flashing. Puncture gasket cleanly and fit tightly to protruding foundation anchor bolts.
- B. Coordinate installation of wood decking, glue laminated structural units, prefabricated wood trusses, and plywood web joists.
- C. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- D. Coordinate curb installation with installation of decking and support of deck openings.

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### 3.8 INSTALLATION OF SHEATHING

- A. Floor Sheathing: Glue and nail to framing; staples are not permitted.
- B. Roof Sheathing: Secure panels perpendicular to framing members, with ends staggered and sheet ends over firm bearing.
  - 1. Use sheathing clips between roof framing members.
  - 2. Support panel edges as indicated on Structural Drawings.
  - 3. Nail panels to framing; staples are not permitted.
- C. Wall Sheathing: Secure with long dimension parallel to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

### 3.9 BUILDING WRAP

- A. Install as recommended by manufacturer.
  - 1. Install to cover upstanding flashings with a minimum 4 inch overlay.

### 3.10 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

### 3.11 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

**END OF SECTION 06100**



## SECTION 06150

### WOOD DECKING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Plywood structural wood decking.
- B. Glued laminated structural wood decking.
- C. Composite wood decking.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. AITC 110 - Standard Appearance Grades for Structural Glued Laminated Timber; American Institute of Timber Construction; 2001.
- B. AITC 113 - Standard for Dimensions of Structural Glued Laminated Timber; American Institute of Timber Construction; 2001.
- C. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber; American Institute of Timber Construction; 2007.
- D. ASTM D 2559 - Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions; 2004.
- E. PS 1 - Structural Plywood; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Plywood Decking:
  - 1. Boise Cascade, LLC: [www.bc.com](http://www.bc.com).
  - 2. Georgia-Pacific Corporation: [www.gp.com](http://www.gp.com).
  - 3. Weyerhaeuser Co: [www.weyerhaeuser.com](http://www.weyerhaeuser.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Glued Laminated Decking:
  - 1. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- C. Composite Wood Decking:
  - 1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 2. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 WOOD MATERIALS

- A. Wood fabricated from old growth timber is not permitted.
- B. Plywood Decking: PS 1 veneer plywood; APA Rated Sheathing, Span Rating \_\_\_\_; Exterior grade; 1 A interior veneer appearance grade; sanded.
- C. Glued Laminated Decking: Softwood lumber of any species fabricated to comply with AITC 190.1 and AITC 113, laminated with adhesive tested according to ASTM D 2559 for wet service; beveled edges, single tongue.
  - 1. Appearance: Fabricate to AITC 110 Industrial grade.

2. After end trimming, seal with penetrating sealer.
- D. Composite Decking: Recycled hardwood mixed with polypropylene and molded into standard lumber board sizes and accessory shapes; minimum polypropylene content of 40 percent.
1. Texture: Molded wood grain finish one side; smooth, matte finish on the other.
  2. Color: Select from manufacturer's standard colors.
  3. Edges, Field Boards: Tongue and groove.
  4. Surface Burning Characteristics: Flame spread index of 80, maximum; smoke developed index of 285, maximum; when tested in accordance with ASTM E 84.

### **2.03 ACCESSORIES**

- A. Fasteners and Anchors:
1. Fastener Type and Finish for Composite Decking: Stainless steel, trim head.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that support framing is ready to receive decking.

### **3.02 PREPARATION**

- A. Coordinate placement of bearing items.

### **3.03 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

### **3.04 INSTALLATION - PLYWOOD DECKING**

- A. Install decking perpendicular to framing members, with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- B. Engage plywood tongue and groove edges.
- C. Allow expansion space at edges and ends.
- D. Use sheathing clips at unsupported edges of plywood between supporting framing members.
- E. Cut decking to accommodate roof drain and flange.

### **3.05 INSTALLATION - BOARD DECKING**

- A. Install decking perpendicular to framing members, with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- B. Engage decking tongue and groove edges.
- C. Secure with fasteners. Side spike planks together, through pre-drilled holes.
- D. Cut decking to accommodate roof drain and flange.

### **3.06 TOLERANCES**

- A. Surface Flatness of Decking Without Load: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/2 inch in 30 feet (12 mm / 9 m) maximum.

**END OF SECTION**

**SHOP-FABRICATED WOOD TRUSSES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Shop fabricated wood trusses (Joists) for floor and roof framing.
- B. Bridging, bracing, and anchorage.
- C. Preservative treatment of wood.

**1.2 RELATED SECTIONS**

- A. Section 06100 - Rough Carpentry.

**1.3 REFERENCES**

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2000.
- B. AWPA - Use Category System (UCS); 2003.
- C. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; Redwood Inspection Service; 2000.
- D. SPIB (GR) - Standard Grading Rules for Southern Pine Lumber; Southern Pine Inspection Bureau, Inc.; 1994.
- E. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 1995, Revised 2/96 (ANSI/TPI 1).
- F. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; Truss Plate Institute; 1989.
- G. TPI HIB-91 - Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses; Truss Plate Institute; 1991.

**1.4 SYSTEM DESCRIPTION**

- A. Design floor live and dead load: See plans with live load deflection limited to L/480.
- B. Design roof live and dead load: See plans with live load deflection limited to L/360.

**1.5 SUBMITTALS**

- A. Shop Drawings: Indicate sizes and spacing of trusses, loads and truss cambers, framed openings. Submit design calculations.
- B. Shop drawings shall be signed and sealed by a Professional Engineer who is registered/licensed in the state of the project.

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- C. General: Submit the following in accordance with Submittal Requirements specified in Section 01 1100 General Requirements.
- D. Product data for the following products:
  - 1. Engineered wood products.
  - 2. Construction adhesives.
- E. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of review of American Lumber Standards Committee.
- F. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
  - 1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
  - 2. For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.
  - 3. For fire-retardant-treated wood products include certification by treating plant that treated material complied with specified standard and other requirements.
  - 4. Warranty of chemical treatment manufacturer for each type of treatment.
- G. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
  - 1. Engineered wood products.
  - 2. Metal framing anchors.

### 1.6 QUALITY ASSURANCE

- A. Truss Design, Fabrication, and Installation: In accordance with TPI 1, TPI DSB-89, and HIB-91.
- B. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Design truss systems under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of the project.
- D. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:
  - 1. "Design Specification for Metal plate Connected Wood Trusses."
  - 2. "Design Specification for Metal plate Connected Parallel Chord Wood trusses."
  - 3. "Commentary and Recommendations for Handling and Erecting Wood Trusses."
  - 4. "Commentary and Recommendations for Bracing Wood Trusses."
- E. Connector Plate Manufacturer's Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Standard for Metal Connector Plate Manufacture."

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- F. Wood Structural Design Standard: Comply with applicable requirements of NFPA "National Design Specification for Wood Construction."
- G. Single-Source Engineering Responsibility: Provide trusses engineered by the metal plate connector manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a qualified professional engineer.
- H. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of metal-plate-connected wood trusses similar to those of this Project that have a record of successful in-service performance:
  - 1. Fabricator participates in a recognize quality assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute; or other independent inspection and testing agency acceptable to Architect and authorities having jurisdiction.
- I. Single Source Responsibility for Connector Plates: Provide metal connector plates from a single manufacturer.

### 1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for loads, seismic zoning, other governing load criteria.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and erect trusses in accordance with TPI HIB-91.
- B. Store trusses in vertical position resting on bearing ends.

### 1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Lumber Grading Rules: RIS (GR).
- B. Wood Members: Single top and bottom chord, Stress Group 4, 19 percent maximum and 7 percent minimum moisture content.
- C. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A 653 Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as indicated.
- D. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

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### 2.2 ACCESSORIES

- A. Wood Blocking and Framing for Openings: In accordance with Section 06100; soft-wood lumber, S/P/F species, construction grade, 19 percent maximum and 7 percent minimum moisture content.
- B. Fasteners: Electro-galvanized unfinished steel, type to suit application.

### 2.3 FACTORY WOOD TREATMENT

- A. Pressure Treatment of Lumber in Contact with Soil: AWWPA Use Category UC2: 0.25 ACQ/0.20 CBA/0.10 CA-B. Also as indicated in Contract Drawings.

### 2.4 FABRICATION

- A. Fabricate trusses to achieve structural requirements specified.
- B. Brace wood trusses in accordance with TPI DSB-89 and TPI HIB-91.

### 2.5 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates from metal complying with requirements indicated in this article.
- B. Hot-Dip Galvanized Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 446 , Grade A; zinc coated by hot-dip process to comply with ASTM A 525 G60 , minimum coated metal thickness indicated but not less than 0.036 inch
- C. Electrolytic Zinc-Coated Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 591 , Coating Class C, and, for structural properties, with ASTM A 446 , Grade A; zinc coated by electro-deposition; minimum coated metal thickness indicated but not less than 0.047 inch .
- D. Aluminum-Zinc Alloy-Coated Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 792, Coating Designation AZ 50, and for structural properties, with ASTM A 446, Grade A; aluminum-zinc alloy-coated by hot-dip process; with minimum coated metal thickness indicated but not less than 0.036 inch.
- E. Stainless Steel Sheet: chromium nickel steel sheet complying with ASTM A 167 Type 304, and, for structural properties, with ASTM A 446, Grade A; with minimum coated metal thickness indicated but not less than 0.035 inch.

### 2.6 FASTENERS

- A. General: Provide Fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, wire, Brads, and Staples: FS FF-N-105.

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- C. Wood Screws: ANSI B18.6.1.
- D. Lag Bolts: ANSI B18.2.1.

### 2.7 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints with wood-to-wood bearing in assembled units.
- B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances specified in TPI "Quality Standard for Metal Plate Connected Wood Trusses." Position members to produce design camber indicated.
- D. Connect truss members by means of metal connector plates accurately located and securely fastened to each side of wood members by means indicated or approved.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that supports and openings are ready to receive trusses.

### 3.2 PREPARATION

- A. Coordinate placement of bearing items.

### 3.3 ERECTION

- A. Install trusses in accordance with manufacturer's instructions.
- B. Set members level and plumb, in correct position.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Do not field cut or alter structural members without approval of Architect.
- E. Place permanent bridging and bracing.
- F. Place headers and supports to frame openings required.
- G. Frame openings between trusses with lumber in accordance with Section 06100.
- H. Coordinate placement of decking with work of this section.
- I. Where trusses do not fit, return them to fabricator and replace with trusses of correct size; do not alter trusses in the field.

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- J. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacings indicated.
- K. Hoist trusses in place by means of lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

3.4 TOLERANCES

- A. Framing Members: 1/2 inch maximum, from true position.

**END OF SECTION**

## SECTION 06176

### WOOD I-JOISTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wood I-joists for roof and floor framing.
- B. Bridging, bracing, and anchorage.
- C. Framing for openings.
- D. Preservative treatment of wood.

##### 1.02 REFERENCE STANDARDS

- A. ASTM D 5055 - Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2007.
- B. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2004.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.
- C. Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.
- D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Wood I-Joists:
  - 1. Georgia-Pacific Corporation: [www.gp.com](http://www.gp.com).
  - 2. Louisiana-Pacific Corp: [www.lpcorp.com](http://www.lpcorp.com).
  - 3. iLevel by Weyerhaeuser: [www.ilevel.com](http://www.ilevel.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 MATERIALS

- A. Wood I-Joists: Solid lumber top and bottom flanges and oriented strand board (OSB) webs bonded together with structural adhesive, with published span rating to meet project requirements.
  - 1. Span Rating: Established and monitored in accordance with ASTM D 5055 by independent inspection agency.
  - 2. Oriented Strand Board: Comply with PS 2.
  - 3. Adhesive: Tested for wet/exterior service in accordance with ASTM D 2559.
  - 4. Fabrication Tolerances:
    - a. Flange Width: Plus/minus 1/3 inch (0.8 mm).
    - b. Flange Thickness: Minus 1/16 inch (1.6 mm).
    - c. Joist Depth: Plus 0, minus 1/8 inch (3.2 mm).
  - 5. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.

- B. Wood-Based Components:
  - 1. Wood fabricated from old growth timber is not permitted.
- C. Joist Bridging: Type, size and spacing recommended by joist manufacturer.
- D. Fasteners: Electrogalvanized steel, type to suit application.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that supports and openings are ready to receive joists.

#### **3.02 PREPARATION**

- A. Coordinate placement of bearing items.

#### **3.03 ERECTION**

- A. Install joists in accordance with manufacturer's instructions.
- B. Set structural members level and plumb, in correct position.
- C. Make provisions for erection loads and for sufficient temporary bracing to maintain structure plumb and in true alignment until completion of erection and installation of permanent bracing.
- D. Install permanent bridging and bracing.
- E. Install headers and supports to frame openings required.

#### **3.04 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment in accordance with manufacturer's instructions.

**END OF SECTION**

## SECTION 06200

### FINISH CARPENTRY

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood door frames, glazed frames.
- C. Wood casings and moldings.
- D. Hardware and attachment accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 09900 (09 9000) - Paints and Coatings: Painting and finishing of finish carpentry items.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.
- B. ANSI A208.1 - American National Standard for Particleboard; 1999.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004.
- D. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2007.
- E. PS 1 - Structural Plywood; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, to a minimum scale of 1-1/2 inch to 1 ft (1:8).
- C. Samples: Submit two samples of wood trim 6 inch (152 mm) long.

##### 1.05 QUALITY ASSURANCE

- A. Grade materials in accordance with the following:
  - 1. Softwood Lumber: In accordance with rules certified by ALSC; [www.alsc.org](http://www.alsc.org).
  - 2. Plywood: Certified by the American Plywood Association.
  - 3. Hardwood Lumber: In accordance with NHLA Grading Rules; [www.natlhardwood.org](http://www.natlhardwood.org).
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum three years of documented experience.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS - GENERAL

- A. Unless otherwise indicated provide products of quality specified by AWI Architectural Woodwork Quality Standards Illustrated for Premium grade.

- B. Unless otherwise indicated provide products of quality specified by Woodwork Institute Manual of Millwork for Premium grade.

## **2.02 WOOD-BASED COMPONENTS**

### **2.03 SHEET MATERIALS**

- A. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B; glue type as recommended for application.
- B. Softwood Plywood Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B; glue type as recommended for application.
- C. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; glue type as recommended for application.
- D. Particleboard: ANSI A208.1; composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.
- E. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch (6 mm) thick, smooth one side (S1S).
- F. Pegboard: Pressed wood fiber with resin binder, standard grade; 1/8 in (3 mm) thick, with holes spaced at 1 in (25 mm) on center in both directions.

### **2.04 ACCESSORIES**

- A. Wood Filler: Solvent base, tinted to match surface finish color.

### **2.05 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

### **2.06 SHOP FINISHING**

- A. Apply wood filler in exposed nail and screw indentations.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

### **3.02 INSTALLATION**

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim to conceal larger gaps.

### **3.03 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply one coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

### **3.04 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09900 (09 9000).

### **3.05 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch (1.5 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

**END OF SECTION**



## SECTION 06410

### CUSTOM CABINETS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

##### 1.02 RELATED REQUIREMENTS

- A. Section 08800 (08 8000) - Glazing: Glass for casework.
- B. Section 09900 (09 9000) - Paints and Coatings: Site finishing of cabinet exterior.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.
- B. ANSI A208.1 - American National Standard for Particleboard; 1999.
- C. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- D. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- E. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.9).
- F. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- G. PS 1 - Structural Plywood; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Provide data for hardware accessories.

##### 1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- B. Perform cabinet construction in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- D. Manufacturer Qualifications: Member in good standing of the Architectural Woodwork Institute (AWI) or the Architectural Woodwork Manufacturers Association of Canada (AWMAC) and familiar with the AWI/AWMAC QSI.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from moisture damage.

## **1.07 FIELD CONDITIONS**

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

## **PART 2 PRODUCTS**

### **2.01 WOOD-BASED COMPONENTS**

#### **2.02 PANEL MATERIALS**

- A. Softwood Faced Plywood:
- B. Exposed Surfaces: PS 1; APA A-A Grade, plain-sliced white oak face veneer, Interior rated adhesives, core of particleboard, medium density fiberboard, or engineered combination, thickness as indicated.
- C. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with interior grade adhesive under heat and pressure; sanded faces; thickness as required; use for components indicated on drawings.
- D. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
- E. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch (6 mm) thick, smooth two sides (S2S); use for drawer bottoms, dust panels, and other components indicated on drawings.
- F. Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

#### **2.03 LAMINATE MATERIALS**

- A. Manufacturers:
  - 1. Formica Corporation: [www.formica.com](http://www.formica.com).
  - 2. Wilsonart International, Inc: [www.wilsonart.com](http://www.wilsonart.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as indicated.

#### **2.04 ACCESSORIES**

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness, color as selected from manufacturer's standards.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel, or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.

- F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

## **2.05 HARDWARE**

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- C. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- D. Drawer and Door Pulls: "U" shaped wire pulls, steel with oil rubbed bronze US10B finish, 4 inch center .
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Catches: Magnetic.
- G. Drawer Slides:
  - 1. Type: Full extension.
  - 2. Static Load Capacity: Heavy Duty grade.
  - 3. Mounting: Side mounted.
  - 4. Stops: Integral type.
  - 5. Features: Provide self closing/stay closed type.
  - 6. Manufacturers:
    - a. Accuride International, Inc: [www accuride.com](http://www accuride.com).
    - b. Knape & Vogt Manufacturing Company: [www.knapeandvogt.com](http://www.knapeandvogt.com).
    - c. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- H. Hinges: European style concealed self-closing type, steel with polished finish.
- I. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.

## **2.06 SITE FINISHING MATERIALS**

- A. Stain, Shellac, Varnish and Finishing Materials: As specified in Section 09900 (09 9000).

## **2.07 FABRICATION**

- A. Cabinet Style: As indicated for each location.
- B. Cabinet Doors and Drawer Fronts: As indicated.
- C. Drawer Construction Technique: Dovetail joints.
- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
- H. Matching Wood Grain: Comply with requirements of quality standard for specified Grade exclusively.
- I. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- J. Shop glaze glass materials using the Interior Dry method specified in Section 08800 (08 8000).

## **2.08 FACTORY FINISHING**

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1500, Nitrocellulose Lacquer, Transparent.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

### **3.02 INSTALLATION**

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim for this purpose.
- C. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

### **3.03 ADJUSTING**

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

### **3.04 CLEANING**

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION**

## SECTION 06415

### COUNTERTOPS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Countertops for architectural cabinetwork.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06410 (06 4100) - Custom Cabinets.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 1999.
- B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- C. AWI/AWMAC (QSI) - Quality Standard Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- E. PS 1 - Structural Plywood; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

##### 1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## **PART 2 PRODUCTS**

### **2.01 COUNTERTOP ASSEMBLIES**

- A. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
  - 1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3 Grade HGP, for postforming, 0.039 inch (HGP, for postforming, 1.0 mm) nominal thickness.
    - a. Finish: Matte or suede, gloss rating of 5 to 20.
    - b. Surface Color and Pattern: To be selected from manufacturer's full line.
    - c. Manufacturers:
      - 1) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 2) Lamin-Art, Inc: [www.laminart.com](http://www.laminart.com).
      - 3) Wilsonart International, Inc: [www.wilsonart.com](http://www.wilsonart.com).
      - 4) Substitutions: See Section 01600 (01 6000) - Product Requirements.
  - 2. Exposed Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch (32 mm) thick with radiused edge, integral coved backsplash with radiused top edge.
  - 3. Exposed Edge Treatment: Molded rubber edge with T-spline, sized to completely cover edge of panel.
    - a. Color: As selected by Architect from the manufacturer's full line.
  - 4. Back and End Splashes: Same material, same construction.
  - 5. Fabricate in accordance with AWI/AWMAC Quality Standards Illustrated Premium Grade.
- B. Natural Stone Countertops: Stone slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
  - 1. Stone: Granite without cracks, voids, or pin holes.
  - 2. Color: As indicated on drawings.
  - 3. Stone Thickness: 1/2 inch (12 mm), minimum.
  - 4. Surface Finish: Honed, non-glare.
  - 5. Exposed Edge Treatment: Square profile stone, 1 inch (25 mm) thick, with 3/16 inch (5 mm) radius corner.
  - 6. Back and End Splashes: Same material, same thickness; for field attachment.

### **2.02 ACCESSORY MATERIALS**

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- E. Joint Sealant: Mildew-resistant silicone sealant, clear.

### **2.03 FABRICATION**

- A. Fabricate in accordance with standards governing fabrication quality that are specified in Section 06410 (06 4100).
- B. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- C. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
    1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
    2. Height: 4 inches (102 mm), unless otherwise indicated.
  - D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.03 INSTALLATION**

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- C. Seal joint between back/end splashes and vertical surfaces.

#### **3.04 CLEANING**

- A. Clean countertops surfaces thoroughly.

#### **3.05 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**



## SECTION 06423

### WOOD VENEER FACED PANELING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Custom wood veneer paneling.
- B. Site finishing.

##### 1.02 RELATED REQUIREMENTS

- A. Section 09900 (09 9000) - Paints and Coatings: Site finishing of wood veneer faced paneling.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 1999.
- B. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004 (ANSI/HPVA HP-1).
- D. PS 1 - Structural Plywood; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, surface graining elevations of sheet paneling, fastening methods, joining methods, and interruptions to other work, to a minimum scale of 1-1/2 inch to 1 ft (1:8). Include plan of panel number sequencing.
- C. Samples: Submit two samples of finished plywood, 6"x6" inch (152x152 mm) in size, illustrating wood grain and specified finish.
- D. Samples: Submit two samples of wood trim, 6 inch (152 mm) long.

##### 1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum three years of documented experience.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI Quality Standards Illustrated.

#### PART 2 PRODUCTS

##### 2.01 SHEET MATERIALS

- A. Softwood Plywood: PS 1 Grade C-D; Graded in accordance with AWI/AWMAC Quality Standards Illustrated, Custom quality; veneer core; face species, cut; of grain quality suitable for transparent finish.

- B. Hardwood Plywood: Graded in accordance with AWI/AWMAC Quality Standards Illustrated, Custom quality; veneer core, type of glue recommended for application; face species, sliced; of grain quality suitable for transparent finish.
- C. Particleboard: Complying with ANSI A208.1 and AWI/AWMAC Quality Standards Illustrated; composed of wood chips, medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

## **2.02 ADHESIVES AND FASTENERS**

- A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.

## **2.03 ACCESSORIES**

- A. Primer: Alkyd primer sealer type.
- B. Wood Filler: Tinted to match surface finish color.

## **2.04 FABRICATION**

- A. Fabricate to AWI/AWMAC Quality Standards Illustrated Custom quality, of Flush design.
- B. Fabricate panels with book matching between adjacent leaves.
- C. Prepare panels for delivery to site, permitting passage through building openings.
- D. Finish exposed edges of panels as specified by grade requirements.
- E. Sand work smooth, ready for finishing.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

### **3.02 INSTALLATION**

- A. Install work in accordance with requirements of AWI/AWMAC Quality Standards Illustrated for specified grade.
- B. Do not begin installation until wood materials have been fully acclimated to interior conditions as recommended by AWI/AWMAC Quality Standards Illustrated.
- C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.
- D. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.
- E. Set exposed fasteners, fill with wood filler, and finish to match panel finish.
- F. Touch up damaged finish to match original, using materials provided by fabricator; replace components that cannot be refinished like new.

### **3.03 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: Refer to Section 09900 (09 9000).

### **3.04 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch (1.5 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

**END OF SECTION**



## SECTION 07212

### BOARD AND BATT INSULATION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall and locations not specified in related Sections.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05400 (05 4000) - Cold Formed Metal Framing: Supporting construction for batt insulation.
- B. Section 06100 (06 1000) - Rough Carpentry: Supporting construction for batt insulation.
- C. Section 07260 (07 2500) - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07840 (07 8400) - Firestopping.
- E. Section 09260 (09 2116) - Gypsum Board Assemblies: Acoustic insulation.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2007.
- B. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2006.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- D. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.

#### PART 2 PRODUCTS

##### 2.01 APPLICATIONS

- A. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
- B. Insulation in Wood Framed Walls: Batt insulation with separate vapor retarder.
- C. Insulation in Wood Framed Ceiling Structure: Batt insulation with separate vapor retarder.
- D. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

##### 2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
  - 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E 84.
  - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
  - 3. Board Size: 48 x 96 inch (1220 x 2440 mm).
  - 4. Board Thickness: 1-1/2 inches (37.5 mm).
  - 5. Board Edges: Tongue-and-groove.
  - 6. Thermal Conductivity (k factor) at 25 degrees F (-3.9 degrees C): 0.18 (0.31).
  - 7. Manufacturers:

- a. Dow Chemical Co: [www.dow.com](http://www.dow.com).
  - b. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  - c. Pactiv Building Products: [greenguard.pactiv.com](http://greenguard.pactiv.com).
8. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.03 BATT INSULATION MATERIALS**

- A. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
  1. Combustibility: Non-combustible, when tested in accordance with ASTM E 136, except for facing, if any.
  2. Formaldehyde Content: Zero.

### **2.04 ACCESSORIES**

- A. Sheet Vapor Retarder: Specified in Section 07260 (07 2500).
- B. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch (50 mm) wide.
- C. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- D. Nails or Staples: Steel wire; electroplated, or galvanized; type and size to suit application.
- E. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- F. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch (6 mm) thick.
- G. Adhesive: Type recommended by insulation manufacturer for application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### **3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Install boards horizontally on foundation perimeter.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### **3.03 BATT INSTALLATION**

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- F. Staple or nail facing flanges in place at maximum 6 inches (150 mm) on center.
- G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

- H. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches (150 mm) on center. Lap and seal sheet retarder joints over member face.
- I. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- J. Tape seal tears or cuts in vapor retarder.
- K. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

#### **3.04 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**



## SECTION 07260

### WEATHER BARRIERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air-tight or vapor retardant.
- B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor-resistant and air-tight.
- C. Air Barriers: Materials to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03300 (03 3000) - Cast-In-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 07212 (07 2100) - Board and Batt Insulation: Vapor retarder installed in conjunction with batt insulation.

##### 1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, vapor retarders, or water-resistive barriers.
- B. Air Barrier: Air-tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- C. Vapor Retarder: Air-tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
  - 1. Water Vapor Permeance: For purposes of conversion,  $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$ .
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture-resistant, to the degree specified, intended to be installed to shed water without sealed seams.

##### 1.04 REFERENCE STANDARDS

- A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2008.
- B. ASTM D 1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2001.
- C. ASTM D 4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2008.
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- E. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- F. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials; 2003.
- G. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2009.

##### 1.05 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

#### **1.06 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

### **PART 2 PRODUCTS**

#### **2.01 WEATHER BARRIER ASSEMBLIES**

- A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
  - 1. Use building paper unless otherwise indicated.
  - 2. Under Portland cement stucco, use one layer of building paper installed over air barrier.
- B. Air Barrier:
  - 1. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.
- C. Interior Vapor Retarder:
- D. Exterior Vapor Retarder:

#### **2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER NOR VAPOR RETARDER)**

- A. Building Paper: Asphalt-saturated kraft building paper complying with requirements of ICC-ES AC308 Grade D.

#### **2.03 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)**

- A. Air Barrier Sheet, Mechanically Fastened:
  - 1. Air Permeance: 0.004 cubic feet per square foot (0.02 liters per second per square meter), maximum, when tested in accordance with ASTM E 2178.
  - 2. Water Vapor Permeance: 5 perms (287 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E 96M Procedure A (desiccant method).
  - 3. Water Penetration Resistance: Withstand a water head of 21 inches (55 cm), minimum, for minimum of 5 hours, when tested in accordance with AATCC 127.
  - 4. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 9 months weather exposure.
  - 5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E 84.
  - 6. Products:
    - a. DuPont Company; Tyvek CommercialWrap: [www.dupont.com](http://www.dupont.com).
    - b. Substitutions: See Section 01600 (01 6000) - Product Requirements.

#### **2.04 VAPOR RETARDER MATERIALS**

- A. Vapor Retarder Sheet: ASTM D 4397 polyethylene film reinforced with glass fiber square mesh, clear.
  - 1. Thickness: 10 mil (0.25 mm).
  - 2. Water Vapor Permeance: As required by referenced standard for thickness specified.
- B. Vapor Retarder Tape: Bright aluminum self adhering type, mesh reinforced, 2 inches (50 mm) wide, compatible with sheet material.

#### **2.05 ACCESSORIES**

- A. Self-Adhesive Sheet Flashing: ASTM D 1970.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### **3.02 PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

### **3.03 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
- C. Air Barriers: Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- D. Vapor Retarders: Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- E. Mechanically Fastened Sheets - On Exterior:
  - 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
  - 2. Overlap seams as recommended by manufacturer but at least 6 inches.
  - 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches (305 mm).
  - 4. For applications specified to be air-tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
  - 5. Install water-resistive barrier over jamb flashings.
  - 6. Install air barrier and vapor retarder UNDER jamb flashings.
  - 7. Install head flashings under weather barrier.
  - 8. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- F. Openings and Penetrations in Exterior Weather Barriers:
  - 1. Install self-adhesive flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
  - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with self-adhesive flashing at least 4 inches (100 mm) wide; do not seal sill flange.
  - 3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using self-adhesive flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
  - 4. At head of openings, install self-adhesive flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
  - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
  - 6. Service and Other Penetrations: Form self-adhesive flashing around penetrating item and seal to weather barrier surface.

### **3.04 FIELD QUALITY CONTROL**

- A. Do not cover installed weather barriers until required inspections have been completed.

### **3.05 PROTECTION**

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

**END OF SECTION**

## SECTION 07322

### CONCRETE ROOF TILES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete roof tiles.
- B. Underlayment, including ice dam protection.
- C. Wood attachment members (battens, nailers, etc.).
- D. Wood nailing battens and counter battens.
- E. Metal roof flashing and counterflashing.
- F. Fasteners and accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06100 (06 1000) - Rough Carpentry: Material requirements for attachment members (battens, nailers, etc.).
- B. Section 07620 (07 6200) - Sheet Metal Flashings and Trim: Roof flashing.
- C. Section 07720 (07 7200) - Roof Accessories: Snow guards.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 1492 - Standard Specification for Concrete Roof Tile; 2003 (Reapproved 2009).
- B. ASTM D 1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2001.
- C. ASTM D 4479 - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007.
- D. ASTM D 4869 - Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing; 2005.
- E. NRCA MS104 - The NRCA Steep Roofing Manual; National Roofing Contractors Association; 2001, Fifth Edition, with interim updates.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on tile and underlayment, indicating material characteristics, installation instructions, and limitations and precautions.
- C. Shop Drawings: For metal flashings and counterflashings, indicate overall configurations and thicknesses, details at complex intersections, jointing methods and locations, and fastening details.
- D. Selection Samples: Submit color chips representing manufacturer's full range of available tile colors and finishes.
- E. Verification Samples: Set of tiles representing actual product in color, finish, and style, including special shapes and fittings.

- F. **Manufacturer's Certificates:** Certify that tiles supplied for the project meet or exceed specified requirements.
- G. **Maintenance Materials:** Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.
  - 2. **Extra Roof Tiles:** Quantity equal to 5 percent of total installed, including appropriate quantities for each color, size, and shape.

### **1.05 MOCK-UP**

- A. Provide a mock-up for evaluation of tile installation workmanship, including typical eave, rake, valley, and ridge detail.
  - 1. Minimum mock-up size: 10 ft by 10 ft (3048 mm by 3048 mm).
  - 2. Do not proceed with remaining work until workmanship has been approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.
  - 4. Approved mock-up may be retained as part of the Work.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### **1.07 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a 5 year period after Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. **Concrete Roof Tiles:**
  - 1. Design is based on Barcelona, Cliffside tiles manufactured by MonierLife Tile.
  - 2. Acceptable manufacturers:
    - a. MonierLifetile LLC: [www.monierlifetile.com](http://www.monierlifetile.com).

### **2.02 ROOF TILES**

- A. **Concrete Roof Tiles:**
  - 1. Comply with requirements for ASTM C 1492, including certification for passing the freeze-thaw testing, and with nail holes made before curing.
  - 2. Weight: Normal weight tile, using ASTM C 33 aggregates.
  - 3. Profile: Barcelona.
  - 4. Tile Size: As indicated.
  - 5. Vertical Exposure: As recommended by manufacturer for roof slope and climatic conditions.
  - 6. Finish: Natural, uncoated, with integral color from metal oxide pigments.
  - 7. Color: Cliffside.
- B. **Special Shapes and Fittings:** Supply special shapes and fittings of same material and finish as adjacent tile, factory-formed, as indicated on drawings or as required for specific project conditions, including but not limited to hip caps, ridge caps, rake edges, eave edges, and termination caps.

### **2.03 SHEET MATERIALS**

- A. Underlayment: Self-adhering polymer-modified asphalt sheet complying with ASTM D 1970; minimum thickness of 40 mils (1 mm); with strippable release paper and slip-resistant embossed polyethylene sheet top surface.
- B. Flexible Flashing: Self-adhering polymer-modified asphalt sheet complying with ASTM D 1970; minimum thickness of 40 mils (1 mm); with strippable release paper and slip-resistant embossed polyethylene sheet top surface.

### **2.04 METAL FLASHING MATERIALS**

- A. Provide metal roof flashings as indicated and as required for watertight roofing system, including eave edge, gable edge, ridge vent, open valley, and chimney flashing.
  - 1. Form flashings to profiles indicated, or as required to shed water and protect building from water damage.
  - 2. Form sections square, flat, and accurate to profile, in maximum possible lengths, free from distortion or other defects detrimental to function or appearance.
  - 3. Hem exposed edges of flashings minimum 1/4 inch (6 mm) on underside.
  - 4. Coat concealed surfaces of flashings with bituminous paint.
- B. Bituminous Paint: Asphaltic mastic, ASTM D 4479, Type I.

### **2.05 FASTENERS**

- A. Underlayment Fasteners: Hot-dip galvanized steel roofing nails, 11 gage (2.9 mm) thick, sharp pointed with barbed shanks, minimum 3/8 inch (9.5 mm) diameter head, and of length sufficient to penetrate 3/4 inch (19 mm) into substrate or completely through it.

### **2.06 ACCESSORIES**

- A. Attachment Members:
  - 1. Battens: 1 x 2 inch (25 x 50 mm) nominal, spaced as required for tile size.
  - 2. Nailers: Nominal 2 inch (50 mm) thick members, height as required for specific conditions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine structural roof deck for compliance with specified requirements. Verify that roof penetrations and roof openings are correctly installed in proper locations.
- B. Do not begin installation of tile roofing until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Prepare roof deck surfaces using methods recommended by tile manufacturer for achieving best results under project conditions.
- B. Seal roof deck joints wider than 1/16 inch (1.5 mm) with deck tape.
- C. At areas where elastomeric membrane underlayment will be installed, fill knot holes and surface cracks with latex filler, or cover knot holes with sheet metal.
- D. Install eave edge and gable edge flashings tight with fascia, in accordance with SMACNA (ASMM) recommendations. Lap joints minimum 2 inches (50 mm) and seal with plastic cement.

### 3.03 INSTALLATION

- A. Install concrete tile roofing system in accordance with recommendations of tile manufacturer and in accordance with recommendations of NRCA Steep Roofing Manual (MS104).
- B. Eave Protection: Install from eave edge to minimum 2 ft (610 mm) up-slope beyond projected interior face of exterior wall.
  - 1. Install eave protection membrane underlayment in accordance with manufacturer's installation instructions for project substrate.
- C. Underlayment:
  - 1. Roof Slopes of 4/12 to 20/12: Install one layer of underlayment over entire roof area, perpendicular to roof slope, with ends and edges weather lapped a minimum of 4 inches (100 mm). Stagger end laps of each layer, and nail in place.
  - 2. Apply additional layer of underlayment not less than 36 inches (915 mm) wide at valleys.
- D. Metal Valley Flashings:
- E. Sheet Metal Flashing: Install flashing at other locations as indicated and as required by project conditions.
- F. Elastomeric Membrane Flashing: Apply self-adhering membrane flashing in concealed locations where metal flashing would be difficult or impossible to apply effectively.
- G. Attachment Members:
  - 1. Nailers: Install nailers at ridge and hips, directly over underlayment. Protect with additional layer of underlayment before installing ridge and hip tiles and accessories.
  - 2. Battens: Install battens horizontally, fastening securely to deck through underlayment.
- H. Concrete Tile:
  - 1. Install first row of tile at eaves with minimum projection of 1 inches (25 mm).
  - 2. Lay tile square with building lines and parallel with roof slope. Install filler, closure, and mitered pieces as required.
  - 3. Unless otherwise indicated or recommended by tile manufacturer, install tile with minimum of 3 inch (75 mm) headlaps.
  - 4. Cut and fit tiles neatly around vents, pipes, and other projections.
  - 5. Install accessories in accordance with manufacturer's details and recommendations.

### 3.04 PROTECTION

- A. Minimize traffic over finished roof surface. Where walking on roof is absolutely necessary, wear soft-soled shoes and walk on butt of tiles to avoid breakage.
- B. Remove and replace damaged or broken tile before Date of Substantial Completion.

**END OF SECTION**

## SECTION 07540

### THERMOPLASTIC MEMBRANE ROOFING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Mechanically attached system with thermoplastic roofing membrane.
- B. Vapor retarder.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2007.
- B. ASTM D 6878 - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2006a.
- C. FM DS 1-28 - Wind Design; Factory Mutual Research Corporation; 2007.
- D. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.
- C. Specimen Warranty: For approval.
- D. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- E. Samples for Verification: Submit two samples 4 x 4 inches (102 x 102 mm) in size illustrating insulation.
- F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section:
  - 1. With minimum 3 years documented experience.
  - 2. Approved by membrane manufacturer.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.

##### 1.07 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
  - 1. Warranty Term: 20 years.
  - 2. For repair and replacement include costs of both material and labor in warranty.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Thermoplastic Polyolefin Membrane Materials:
  - 1. Carlisle SynTec; : [www.carlisle-syntec.com](http://www.carlisle-syntec.com).
  - 2. Firestone Building Products Co; Headquarters, 525 Congressional Blvd., Carmel, IN 46032-5607: [www.firestonebpco.com](http://www.firestonebpco.com).
  - 3. GenFlex Roofing Systems; : [www.genflex.com](http://www.genflex.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Insulation:
  - 1. Atlas Roofing Corporation: [www.atlasroofing.com](http://www.atlasroofing.com).
  - 2. GAF Materials Corporation: [www.gaf.com](http://www.gaf.com).
  - 3. Dow Chemical Co: [www.dow.com](http://www.dow.com).
  - 4. ISO 95+ Polyisocyanurate Insulation by Firestone.
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.02 ROOFING - UNBALLASTED APPLICATIONS**

- A. Thermoplastic Membrane Roofing: One ply membrane, mechanically fastened, over insulation.
- B. Acceptable Insulation Types - Constant Thickness Application:
- C. Acceptable Insulation Types - Tapered Application:

### **2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS**

- A. Membrane:
  - 1. Material: Thermoplastic polyolefin (TPO) complying with ASTM D 6878.
  - 2. Reinforcing: Scrim.
  - 3. Thickness: 100 mils inch (2.5 mm), minimum.
  - 4. Sheet Width: Factory fabricated into largest sheets possible.
  - 5. Color: White.
  - 6. Solar reflectance index (SRI): 95.
  - 7. Acceptable Product: UltraPly TPO Scrim Reinforced.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Membrane Fasteners:
  - 1. Disc Washers and Screws: Heavy-Duty (HD) fasteners by Firestone.
- D. Vapor Retarder: Non-bituminous, foil and fibrous mesh laminate complying with requirements of fire rating classification; compatible with roofing and insulation materials.
  - 1. Fire-retardant adhesive.
- E. Flexible Flashing Material: Same material as membrane.

### **2.04 INSULATION**

- A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 1, laminated to a black glass reinforced mat facer - Firestone ISO 95+ and with the following characteristics:
  - 1. Thermal Resistance: R-value of 6.0/1 inch.

2. Manufacturer: Firestone.
3. Manufacturers:
  - a. Firestone: [www.firestonebpco.com](http://www.firestonebpco.com).
4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.05 ACCESSORIES**

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
- D. Membrane Adhesive: As recommended by membrane manufacturer.
- E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- F. Insulation Adhesive: As recommended by insulation manufacturer.
- G. Roofing Nails: Galvanized, hot dipped type, size and configuration as required to suit application.
- H. Sealants: As recommended by membrane manufacturer.
- I. Walkway Pads: Type as recommended by membrane manufacturer; size as indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

### **3.02 EXAMINATION**

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

### **3.03 WOOD DECK PREPARATION**

- A. Verify flatness and tightness of joints of wood decking. Fill knot holes with latex filler.

### **3.04 VAPOR RETARDER AND INSULATION - UNDER MEMBRANE**

- A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
  - 1. Extend vapor retarder under cant strips and blocking to deck edge.
  - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation:
  - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- D. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.
- E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- G. Do not apply more insulation than can be covered with membrane in same day.

### **3.05 MEMBRANE APPLICATION**

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (75 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- D. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.
- E. At intersections with vertical surfaces:
  - 1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
  - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

### **3.07 CLEANING**

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

### **3.08 PROTECTION**

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

**END OF SECTION**



## SECTION 07620

### SHEET METAL FLASHING AND TRIM

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, sheet metal roofing, and cap flashings.
- B. Reglets and accessories.
- C. Precast concrete splash pads.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06100 (06 1000) - Rough Carpentry: Wood nailers.
- B. Section 07322 (07 3216) - Concrete Roof Tiles: Flashings associated with concrete roofing tiles.
- C. Section 07611 (07 6100) - Custom Sheet Metal Roofing.
- D. Section 07631 (07 7123) - Gutters and Downspouts.
- E. Section 07720 (07 7200) - Roof Accessories: Roof-mounted units.
- F. Section 08630 (08 6300) - Metal-Framed Skylights: Metal curbs.
- G. Section 09900 (09 9000) - Paints and Coatings: Field painting.

##### 1.03 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.
- B. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- C. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- D. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 4 x 4 inch (102 x 102 mm) in size illustrating metal finish color.

##### 1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

#### PART 2 PRODUCTS

##### 2.01 SHEET MATERIALS

- A. Aluminum: ASTM B 209 (ASTM B 209M); 0.032 inch (0.8 mm) thick; anodized finish of color as selected.
- B. Pre-Finished Aluminum: ASTM B 209 (ASTM B 209M); 0.032 inch (0.8 mm) thick; plain finish shop pre coated with fluoropolymer coating of color as selected.
  - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.

## **2.02 ACCESSORIES**

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant: Type \_\_\_\_ specified in Section 07900 (07 9005).
- E. Plastic Cement: ASTM D 4586, Type I.

## **2.03 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 4 inches (102 mm) over roofing as detailed. Return and brake edges.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### **3.02 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

### **3.03 INSTALLATION**

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.

- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

**END OF SECTION**



## SECTION 07631

### GUTTERS AND DOWNSPOUTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Pre-finished aluminum gutters and downspouts.
- B. Precast concrete splash pads.

##### 1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.
- B. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- C. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

##### 1.03 DESIGN REQUIREMENTS

- A. Conform to SMACNA Architectural Sheet Metal Manual for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.
- B. Conform to applicable code for size and method of rain water discharge.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- C. Product Data: Provide data on prefabricated components.
- D. Samples: Submit two samples, 4x4 inch (102x102 mm) long illustrating component design, finish, color, and configuration.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Gutters and Downspouts:
  - 1. ATAS International, Inc: [www.atas.com](http://www.atas.com).
  - 2. Cheney Flashing Company: [www.cheneyflashing.com](http://www.cheneyflashing.com).
  - 3. Perimeter Systems: [www.perimeter-systems.com](http://www.perimeter-systems.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 MATERIALS

- A. Pre-Finished Aluminum Sheet: ASTM B 209 (ASTM B 209M); 0.032 inch (0.8 mm) thick.

1. Finish: Plain, shop pre-coated with modified silicone coating.
2. Color: As selected from manufacturer's standard colors.

### **2.03 COMPONENTS**

- A. Gutters: Profile as indicated.
- B. Downspouts: SMACNA Rectangular profile.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
  1. Anchoring Devices: In accordance with SMACNA requirements.
  2. Gutter Supports: Spikes and ferrules.
  3. Downspout Supports: Brackets.
- D. Fasteners: Galvanized steel, with soft neoprene washers.

### **2.04 ACCESSORIES**

- A. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.

### **2.05 FABRICATION**

- A. Form gutters and downspouts of profiles and sizes indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

### **2.06 FACTORY FINISHING**

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

### **3.02 PREPARATION**

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

### **3.03 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters 1/16 inch per foot (6.35 mm/m).
- D. Set splash pads under downspouts.

**END OF SECTION**

## SECTION 07720

### ROOF ACCESSORIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Roof hatches, manual and automatic operation, including smoke vents.

##### 1.02 REFERENCE STANDARDS

- A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009.
- B. UL (BMD) - Building Materials Directory; current edition.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance requirements.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

#### PART 2 PRODUCTS

##### 2.01 ROOF HATCHES, MANUAL AND AUTOMATIC OPERATION

- A. Manufacturers - Roof Hatches:
  - 1. Bilco Co.: [www.bilco.com](http://www.bilco.com)
  - 2. Dur-Red Products: [www.dur-red.com](http://www.dur-red.com)
  - 3. Milcor by Commercial Products Group of Hart & Cooley, Inc: [www.milcorinc.com](http://www.milcorinc.com)
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Roof Hatches: Factory-assembled steel frame and cover, complete with operating and release hardware.
  - 1. Style: Provide flat metal covers unless otherwise indicated.
  - 2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
  - 3. Size(s): As indicated on drawings; single-leaf style unless indicated as double-leaf.
  - 4. For Ladder Access: Single leaf, 30 by 36 inches (762 by 914 mm).
- C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
  - 1. Material: prime and painted steel, 14 gage, 0.0747 inch (1.90 mm) thick.
  - 2. Finish: Factory prime paint.
  - 3. Insulation: 1 inch (25 mm) rigid glass fiber, located on inside hollow curb.
  - 4. Curb Height: 12 inches (305 mm) from finished surface of roof, minimum.
- D. Metal Covers: Flush, insulated, hollow metal construction.
  - 1. Capable of supporting 40 psf (1.92 kPa) live load.
  - 2. Material: Prime and painted steel; outer cover 14 gage, 0.0747 inch (1.90 mm) thick, liner 22 gage, 0.03 inch (0.76 mm) thick.

3. Finish: Factory prime paint.
  4. Insulation: 1 inch (25 mm) rigid glass fiber.
  5. Gasket: Neoprene, continuous around cover perimeter.
- E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf (475 kPa) load.
  2. Hinges: Manufacturer's recommended type.
  3. Hold open arm with vinyl-coated handle for manual release.
  4. Latch: Upon closing, engage latch automatically and reset manual release.
  5. Manual Release: Pull handle on interior.
  6. Locking: Padlock hasp on interior.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

#### **3.04 CLEANING**

- A. Clean installed work to like-new condition.

#### **3.05 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

## **SECTION 07900**

### **JOINT SEALERS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Sealants and joint backing.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01616 (01 6116) - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07260 (07 2500) - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders:
- C. Section 07840 (07 8400) - Firestopping: Firestopping sealants.
- D. Section 08800 (08 8000) - Glazing: Glazing sealants and accessories.
- E. Section 09260 (09 2116) - Gypsum Board Assemblies: Acoustic sealant.
- F. Section 09300 (09 3000) - Tile: Sealant used as tile grout.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C 834 - Standard Specification for Latex Sealants; 2005.
- B. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2008.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- D. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2009.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with other sections referencing this section.

##### **1.05 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit 3 samples, illustrating sealant colors for selection.

##### **1.06 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

##### **1.07 MOCK-UP**

- A. Provide mock-up of sealant joints in conjunction with window, wall, and air barrier system under provisions of Section 01400 (01 4000).
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

## 1.08 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

## 1.09 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Silicone Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
  - 3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 4. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Polyurethane Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- C. Polysulfide Sealants:
  - 1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 2. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- D. Acrylic Sealants:
  - 1. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 2. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- E. Butyl Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- F. Acrylic Emulsion Latex Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### 2.02 SEALANTS

- A. Sealants and Primers - General: Provide products having volatile organic compound (VOC) content as specified in Section 01616 (01 6116).
- B. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
  - 1. Color: color as selected.
  - 2. Applications: Use for:
    - a. Control, expansion, and soft joints in masonry.

- b. Joints between concrete and other materials.
  - c. Joints between metal frames and other materials.
  - d. Other exterior joints for which no other sealant is indicated.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
- 1. Color: Colors as selected.
  - 2. Applications: Use for:
    - a. Interior wall and ceiling control joints.
    - b. Joints between door and window frames and wall surfaces.
    - c. Other interior joints for which no other type of sealant is indicated.
- D. Bathtub/Tile Sealant: White silicone; ASTM C 920, Uses I, M and A; single component, mildew resistant.
- 1. Applications: Use for:
    - a. Joints between plumbing fixtures and floor and wall surfaces.
    - b. Joints between kitchen and bath countertops and wall surfaces.
- E. Acoustical Sealant: Butyl or acrylic sealant; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
- 1. Applications: Use for concealed locations only:
    - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
- F. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Class 25, Uses T, I, M and A; single component.
- 1. Color: Gray.
  - 2. Applications: Use for:
    - a. Joints in sidewalks and vehicular paving.
- G. Acrylic Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, O; single component, solvent curing, non-staining, non-bleeding, non-sagging.
- 1. Color: Colors as selected.
  - 2. Movement Capability: Plus and minus 12-1/2 percent.
  - 3. Service Temperature Range: -13 to 180 degrees F (-25 to 82 degrees C).
  - 4. Shore A Hardness Range: 25 to 50.
- H. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
- 1. Color: Color as selected.
  - 2. Movement Capability: Plus and minus 25 percent.
  - 3. Service Temperature Range: -65 to 180 degrees F (-54 to 82 degrees C).
  - 4. Shore A Hardness Range: 15 to 35.

### 2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

### PART 3 EXECUTION

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Perform acoustical sealant application work in accordance with ASTM C 919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

### **3.04 CLEANING**

- A. Clean adjacent soiled surfaces.

### **3.05 PROTECTION**

- A. Protect sealants until cured.

**END OF SECTION**

## SECTION 08110

### STEEL DOORS AND FRAMES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors.

##### 1.02 RELATED REQUIREMENTS

- A. Section 08710 - Door Hardware.
- B. Section 08800 - Glazing: Glass for doors and borrowed lites.
- C. Section 09900 - Paints and Coatings: Field painting.

##### 1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009.
- E. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- F. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2010.
- H. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Steel Doors and Frames:
  - 1. Assa Abloy: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Windsor Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft: [www.steelcraft.com](http://www.steelcraft.com).
  - 4. Substitutions: See Section 01600 - Product Requirements.

#### **2.02 DOORS AND FRAMES**

- A. Requirements for All Doors and Frames:
  - 1. Accessibility: Comply with ANSI/ICC A117.1.
  - 2. Door Top Closures: Flush with top of faces and edges.
  - 3. Door Edge Profile: Beveled on both edges.
  - 4. Door Texture: Smooth faces.
  - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
  - 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
  - 7. Galvanizing for Units in Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
  - 8. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

#### **2.03 STEEL DOORS**

- A. Exterior Doors:
  - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 1, full flush.
  - 2. Core: Polyurethane.
  - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
- B. Interior Doors, Non-Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
  - 2. Core: Cardboard honeycomb.
  - 3. Thickness: 1-3/4 inches (44 mm).
- C. Interior Doors, Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
  - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
    - a. Provide units listed and labeled by UL.

- b. Attach fire rating label to each fire rated unit.

## **2.04 STEEL FRAMES**

- A. General:
  1. Comply with the requirements of grade specified for corresponding door, except:
    - a. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
  2. Finish: Same as for door.
  3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
  4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (100 mm) high to fill opening without cutting masonry units.
- B. Exterior Door Frames: Face welded, seamless with joints filled.
  1. Weatherstripping: Separate, see Section 08710.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
- D. Interior Door Frames, Fire-Rated: Fully welded type.
  1. Fire Rating: Same as door, labeled.

## **2.05 ACCESSORY MATERIALS**

- A. Glazing: As specified in Section 08800, factory installed.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

## **2.06 FINISH MATERIALS**

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

### **3.02 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

### **3.03 INSTALLATION**

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.

### **3.04 TOLERANCES**

- A. Maximum Diagonal Distortion: 1/16 in (1.5 mm) measured with straight edge, corner to corner.

### **3.05 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**END OF SECTION**

## SECTION 08211

### FLUSH WOOD DOORS

#### PART 1 GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. Section 06200 (06 2000) - Finish Carpentry.
- B. Section 08110 (08 1113) - Steel Doors and Frames.
- C. Section 08710 (08 7100) - Door Hardware.
- D. Section 08800 (08 8000) - Glazing.
- E. Section 09900 (09 9000) - Paints and Coatings: Site finishing of doors.

##### 1.02 REFERENCE STANDARDS

- A. ASTM E 413 - Classification for Rating Sound Insulation; 2004.
- B. ASTM E 1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).
- C. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- D. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2010.
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2008.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- H. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. WDMA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2004.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Specimen warranty.
- D. Test Reports: Show compliance with specified requirements for the following:
  - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- E. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing.
- F. Samples: Submit three samples of door construction, 6 by 6 inch (152 by 152 mm) in size cut from top corner of door.
- G. Samples: Submit two samples of door veneer, 12 by 12 inch (305 by 305 mm) in size illustrating wood grain, stain color, and sheen.

- H. Manufacturer's Installation Instructions: Indicate special installation instructions.
- I. Warranty, executed in Owner's name.

#### **1.04 QUALITY ASSURANCE**

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

#### **1.06 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  - 1. Eggers Industries: [www.eggersindustries.com](http://www.eggersindustries.com).
  - 2. Haley Brothers: [www.haleybros.com](http://www.haleybros.com).
  - 3. Marshfield DoorSystems, Inc: [www.marshfielddoors.com](http://www.marshfielddoors.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

#### **2.02 DOORS AND PANELS**

- A. All Doors: See drawings for locations and additional requirements.
  - 1. Quality Level: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S.1-A.
  - 2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.
- B. Interior Doors: 1-3/8 inches (35 mm) thick unless otherwise indicated; flush construction.
  - 1. Provide solid core doors at all locations.
  - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with NFPA 252, UL 10B, or UBC Standard 7-2-94 ("neutral pressure"); UL or WH (ITS) labeled without any visible seals when door is open.
  - 3. Sound Retardant Doors: Minimum STC of 35, calculated in accordance with ASTM E 413, tested in accordance with ASTM E 1408.
  - 4. Wood veneer facing for field transparent finish where indicated on drawings.
  - 5. Wood veneer facing for field opaque finish where indicated on drawings.

### **2.03 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound Retardant Doors: Equivalent to Type PC construction with core as required to achieve rating specified; plies and faces as indicated above.

### **2.04 DOOR FACINGS**

- A. Wood Veneer Facing for Transparent Finish: Species as specified above, veneer grade as specified by quality standard, plain sliced, book veneer match, running assembly match; unless otherwise indicated.
- B. Veneer Facing for Opaque Finish: Medium density overlaid plywood.

### **2.05 ACCESSORIES**

- A. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style screws.

### **2.06 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Provide edge clearances in accordance with AWI Quality Standards Illustrated Section 1700.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Field-Finished Doors: Trimming to fit is acceptable.
  - 1. Adjust width of non-rated doors by cutting equally on both jamb edges.
  - 2. Trim maximum of 3/4 inch (19 mm) off bottom edges.
  - 3. Trim fire-rated doors in strict compliance with fire rating limitations.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

### **3.03 TOLERANCES**

- A. Maximum Diagonal Distortion (Warp): 1/8 inch (3 mm) measured with straight edge or taut string, corner to corner, over an imaginary 36 by 84 inches (915 by 2130 mm) surface area.

**3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**3.05 SCHEDULE - See Drawings**

**END OF SECTION**

## SECTION 08212

### STILE AND RAIL WOOD DOORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wood doors, stile and rail design.
- B. Panels of wood and glass.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06200 (06 2000) - Finish Carpentry: Wood door frames.
- B. Section 08110 (08 1113) - Steel Doors and Frames.
- C. Section 08710 (08 7100) - Door Hardware.
- D. Section 08800 (08 8000) - Glazing.
- E. Section 09900 (09 9000) - Paints and Coatings: Site finishing doors.

##### 1.03 REFERENCE STANDARDS

- A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.
- C. Specimen warranty.
- D. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing.
- E. Samples: Submit three samples of door construction, 6x6 inch (152x152 mm) in size cut from top corner of door.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in Owner's name.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years of documented experience.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with AWI/AWMAC Quality Standards Illustrated, Section 1300.
- B. Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

##### 1.07 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Stile and Rail Wood Doors:
  - 1. Eggers Industries: [www.eggersonindustries.com](http://www.eggersonindustries.com).
  - 2. Maiman Company: [www.maiman.com](http://www.maiman.com).
  - 3. Marshfield DoorSystems, Inc: [www.marshfielddoors.com](http://www.marshfielddoors.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.02 DOOR TYPES**

- A. Interior Doors: 1-3/8 inches (35 mm) thick unless otherwise indicated; solid lumber construction; mortised and tenoned joints.

### **2.03 DOOR AND PANEL FACING**

- A. Interior Doors: Wood veneer, red or white oak species, plain sliced, with book matched grain, for transparent finish.
- B. Adhesive: Type I - waterproof.

### **2.04 ACCESSORIES**

- A. Molding: Wood, of same species as door facing, mitered corners; prepared for countersink style screws.

### **2.05 FABRICATION**

- A. Fabricate in accordance with AWI/AWMAC Quality Standards Illustrated, Section 1400, Premium grade.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and AWI/AWMAC Quality Standards requirements.
- B. Trim door width by cutting equally on both jamb edges.
- C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).
- D. Machine cut for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.

### **3.03 TOLERANCES**

- A. Maximum Diagonal Distortion (Warp): 1/8 inch (3 mm) measured with straight edge or taut string, corner to corner, over an imaginary 36 x 84 inch (915 X 2130 mm) surface area.

### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

### **3.05 SCHEDULE - See Drawings**

**END OF SECTION**



## SECTION 08310

### ACCESS DOORS AND PANELS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Access door and frame units, fire-rated and non-fire-rated, in wall, ceiling, and floor locations.

##### 1.02 RELATED REQUIREMENTS

- A. Section 09900 (09 9000) - Paints and Coatings: Field paint finish.
- B. Section 15820 (23 3300) - Duct Accessories: Access doors in ductwork.

##### 1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Manufacturer's Installation Instructions: Indicate installation requirements.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Access Doors:
  - 1. Acudor Products Inc: [www.acudor.com](http://www.acudor.com).
  - 2. Karp Associates, Inc: [www.karpinc.com](http://www.karpinc.com).
  - 3. Milcor by Commercial Products Group of Hart & Cooley, Inc: [www.milcorinc.com](http://www.milcorinc.com).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 ACCESS DOORS AND PANELS

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
- B. Floor Units: Design to support live load of 100 lb/sq ft (4.7 kPa) with deflection not to exceed 1/180 of span.
- C. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
  - 1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
  - 2. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

##### 2.03 WALL AND CEILING UNITS

- A. Door and Frame Units: Formed steel.
  - 1. Frames and flanges: 0.058 inch (1.5 mm) steel.
  - 2. Door panels: 0.070 inch (1.8 mm) single thickness steel sheet.

3. Size: Furnish sizes to suit conditions but not less than 16 x 16 inches, unless specifically indicated otherwise.
4. Hardware:
  - a. Hinge: Concealed constant force closure spring type.
  - b. Lock: Screw driver slot for quarter turn cam lock.
5. Prime coat with baked on primer.
6. Finish: Two coats baked enamel, color as selected.

#### **2.04 FLOOR UNITS**

- A. Hatch and Frame Units: Extruded aluminum.
  1. Size: As indicated.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

#### **3.02 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

**END OF SECTION**

## SECTION 08351

### ACCORDION FOLDING DOORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Accordion folding doors.
- B. Track and operating hardware.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06100 (06 1000) - Rough Carpentry: Wood supports and blocking for track support.
- B. Section 06200 (06 2000) - Finish Carpentry: Wood perimeter trim.
- C. Section 08710 (08 7100) - Door Hardware: Lock cylinders.

##### 1.03 DESIGN REQUIREMENTS

- A. Design track and anchors to support imposed loads with maximum deflection of 1/360 of span, attached to structural members indicated.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate opening sizes, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking sizes.
- C. Product Data: Provide data on door operation, hardware and accessories, electric operating components, track switching components, colors and finishes available.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and installation sequence.
- E. Maintenance Data: Describe cleaning materials detrimental to surfaces and hardware finish. Include recommended cleaning methods, cleaning materials, and stain removal methods.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications : Company specializing in performing the work of this section with minimum 3 years experience.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. MobilFlex Inc.; Product Aeroflex.
- B. Other Acceptable Manufacturers:
  - 1. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 ACCORDION FOLDING DOORS

- A. Accordion Door Type : Non-acoustical.
  - 1. Finish: Acrylic Paint; Medium Bronze #40 color.
  - 2. Product: Aeroflex -Perforated Steel by MobilFlex Inc..

- B. Track: Formed steel; 1-1/4 x 1-1/4 inches (32 x 32 mm) size; thickness and profile designed to support loads; steel sub-channel.
- C. Carriers: Nylon wheels on trolley carrier at top center of every second fold, with threaded pendant bolt for vertical adjustment.

### **2.03 FINISH MATERIALS**

### **2.04 COMPONENTS**

- A. Hardware: Latching door handles of cast steel, oil rubbed bronze finish; lock cylinder keyed to building keying system; jamb lock and pull bars.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that field measurements are as indicated.

### **3.02 INSTALLATION**

- A. Install door in accordance with manufacturer's instructions.
- B. Fit and align door assembly level and plumb.
- C. Lubricate moving components.

### **3.03 ADJUSTING**

- A. Adjust door to provide smooth operation from stacked to full open position.
- B. Visually inspect door in fully closed position for light leaks to identify a potential acoustical leak. Adjust to achieve light tight seal.

### **3.04 CLOSEOUT ACTIVITIES**

- A. Demonstrate operation of door and identify potential operational problems.

**END OF SECTION**

## SECTION 08410

### METAL-FRAMED STOREFRONTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Door hardware.
- E. Perimeter sealant.

##### 1.02 RELATED REQUIREMENTS

- A. Section 07900 (07 9005) - Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08800 (08 8000) - Glazing: Glass and glazing accessories.

##### 1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2009 (part of AAMA 501).
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- E. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- F. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
- G. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.
- H. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

##### 1.05 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - 1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at a reference differential pressure across assembly of 1.57 psf (75 Pa) as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft (140 Pa).
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

#### **1.06 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.07 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the state in which the Project is located.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### **1.09 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

## 1.10 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Kawneer; Product Trifab VG 451T Center Glazed.
- B. Other Acceptable Manufacturers:
  - 1. YKK AP America Inc; Product \_\_\_\_: [www.ykkap.com](http://www.ykkap.com).
  - 2. United States Aluminum Corp: [www.usalum.com](http://www.usalum.com).
  - 3. Vistawall Architectural Products: [www.vistawall.com](http://www.vistawall.com).
  - 4. Vitro America; Product \_\_\_\_: [www.vitroamerica.com](http://www.vitroamerica.com).
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### 2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  - 1. Glazing Position: Center.
  - 2. Vertical Mullion Dimensions: \_\_\_\_ (\_\_\_\_).s
  - 3. Water Leakage Test Pressure Differential: \_\_\_\_ lbf/sq ft (\_\_\_\_ Pa).
  - 4. Air Infiltration Test Pressure Differential: \_\_\_\_ psf (\_\_\_\_ Pa).
  - 5. Finish: Class I color anodized.
  - 6. Color: Dark bronze.
- B. Performance Requirements:
  - 1. Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
    - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
  - 2. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
  - 3. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at specified differential pressure across assembly in accordance with ASTM E 283.
  - 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  - 5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

### 2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  - 1. Framing members for interior applications need not be thermally broken.
  - 2. Glazing stops: Flush.
  - 3. Cross-Section: As indicated on drawings.
- B. Doors: Glazed aluminum.

1. Thickness: 1-3/4 inches (43 mm).
2. Top Rail: 5 inches (127 mm) wide.
3. Vertical Stiles: 5 inches (127 mm) wide.
4. Bottom Rail: 10 inches (254 mm) wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

#### **2.04 MATERIALS**

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- B. Fasteners: Stainless steel.
- C. Perimeter Sealant: Type specified in Section 07900 (07 9005).
- D. Glass: As specified in Section 08800 (08 8000).
- E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

#### **2.05 FINISHES**

- A. Class I Color Anodized Finish: AAMA 611 AA-C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: As shown on the drawings.

#### **2.06 HARDWARE**

- A. Door Hardware: Storefront manufacturer's standard type to suit application.
  1. Finish on Hand-Contacted Items: Dark Bronze.
  2. Include for each door weatherstripping, sill sweep strip, threshold, pivots, pull handle, narrow stile handle latch, closer, and Panic exit device.

#### **2.07 FABRICATION**

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

#### **3.02 INSTALLATION**

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install hardware using templates provided.
- L. Install glass and infill panels in accordance with Section 08800 (08 8000), using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07900 (07 9005).
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.03 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- B. Test installed storefront for water leakage in accordance with AAMA 501.2.

### **3.05 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

### **3.06 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

**END OF SECTION**



## SECTION 08460

### AUTOMATIC DOOR ACTUATORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Operators for doors provided in other sections.
- B. Actuators and safety devices.
- C. Maintenance.

##### 1.02 RELATED REQUIREMENTS

- A. Section 16155 (26 2717) - Equipment Wiring.

##### 1.03 REFERENCE STANDARDS

- A. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.10).
- B. BHMA A156.19 - American National Standard for Power Assist and Low Energy Power Operated Doors; Builders Hardware Manufacturers Association; 2007 (ANSI/BHMA A156.19).
- C. UL (ECMD) - Electrical Construction Materials Directory; Underwriters Laboratories Inc.; current edition.
- D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
  - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.
  - 2. Wrenches and other tools required for maintenance of equipment.

##### 1.05 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

## **1.06 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

### **2.02 DOOR OPERATORS**

- A. Door Operators - General Requirements: Comply with BHMA A156.10, BHMA A156.19, and UL 325, as applicable.
  - 1. Select equipment to accommodate heavy pedestrian traffic and weight of doors.
  - 2. Provide equipment capable of operating, holding open, and closing doors under positive and negative wind pressures calculated in accordance with applicable code.
  - 3. Provide operators that are fully adjustable for opening and closing speeds, checking speeds, and hold-open time.
  - 4. Swinging Door Operators: Provide for manual open and close operation of door leaves in the event of power failure.
  - 5. Conform to applicable code for automatic release of control drive unit to permit manual opening of doors.
  - 6. Finish exposed components to match door and door hardware finish.
- B. Swinging Door Operator: Electric Concealed overhead.
  - 1. Operation: Power open, spring close operation.
  - 2. Variable speed control for opening and closing cycles.
  - 3. Actuator(s): As indicated on drawings.
  - 4. "Push" Side Actuator: Push plate.
  - 5. "Pull" Side Actuator: Push plate.

### **2.03 ACTUATORS**

- A. Motion Sensor Actuator: Passive infrared; distance of control sensitivity adjustable.
- B. Push Plate Actuator: Standard wall mounted, recessed momentary contact type; satin stainless steel plate; 4 inches (102 mm) diameter; labeled PUSH.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and is of the correct characteristics.

### **3.02 INSTALLATION**

- A. Install equipment in accordance with manufacturer's instructions.

### **3.03 ADJUSTING**

- A. Adjust door equipment for correct function and smooth operation.

### **3.04 CLEANING**

- A. Remove temporary protection, clean exposed surfaces.

### **3.05 CLOSEOUT ACTIVITIES**

- A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

### **3.06 MAINTENANCE**

- A. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

**END OF SECTION**



## SECTION 08520

### ALUMINUM WINDOWS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Extruded aluminum windows with fixed sash and operating sash.
- B. Factory glazing.
- C. Operating hardware.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05500 (05 5000) - Metal Fabrications: Steel lintels.
- B. Section 06100 (06 1000) - Rough Carpentry: Rough opening framing.
- C. Section 06100 (06 1000) - Rough Carpentry: Wood perimeter shims.
- D. Section 07260 (07 2500) - Weather Barriers: Perimeter air and vapor seal between window frame and adjacent construction.
- E. Section 07900 (07 9005) - Joint Sealers: Perimeter sealant and back-up materials.
- F. Section 08800 (08 8000) - Glazing.

##### 1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors; American Architectural Manufacturers Association; 2008.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- C. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- E. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- F. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: As specified in PART 2, with the following additional requirements.
- B. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, or migrating moisture occurring within system.

##### 1.05 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations,, and installation requirements.
- D. Submit two samples of operating hardware.
- E. Certificates: Certify that windows meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer and Installer Qualifications: Company specializing in fabrication of commercial aluminum windows of types required, with not fewer than three years of experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

#### **1.08 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

#### **1.09 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Basis of Design: Kawneer; Product Trifab VG 451T -center and Encore Center Glazed.
- B. Aluminum Windows:
  1. Substitutions: See Section 01600 (01 6000) - Product Requirements.

#### **2.02 WINDOWS**

- A. Windows: Tubular aluminum sections, factory fabricated, factory finished, thermally broken, vision glass, related flashings, anchorage and attachment devices.
  1. Frame Depth: 4-1/2".
  2. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (\_\_\_\_ L/s/sq m) of wall area, measured at a specified differential pressure across assembly in accordance with ASTM E 283.
  3. Water Infiltration Test Pressure Differential: 8 pounds per square foot ( Pa).
- B. Fixed, Non-Operable Type:
  1. Construction: Thermally broken.
  2. Glazing: Double; gray tinted; low-e.
  3. Exterior Finish: Class I color anodized.
  4. Interior Finish: Class I color anodized.
- C. Outswinging Casement Type:

1. Construction: Thermally broken.
2. Glazing: Double; gray tinted; low-e.
3. Exterior Finish: Class I natural anodized.
4. Interior Finish: Class I natural anodized.

### **2.03 COMPONENTS**

- A. Frames: 2 inch (50.8 mm) wide x 4 1/2 inch (114.3 mm) deep profile, of 3/32 inch (2.4 mm) thick section; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of snap-on type.
- B. Sills: 3/32 inch (2.4 mm) thick, extruded aluminum; sloped for positive wash; fit under sash leg to 1/2 inch (12 mm) beyond wall face; one piece full width of opening jamb angles to terminate sill end.
- C. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.

### **2.04 MATERIALS**

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M), 6063 alloy, T6 temper.

### **2.05 HARDWARE**

- A. Sash lock: Lever handle with cam lock.

### **2.06 FABRICATION**

- A. Fabricate components with smallest possible clearances and shim spacing around perimeter of assembly that will enable window installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices.
- D. Arrange fasteners and attachments to ensure concealment from view.
- E. Provide steel internal reinforcement in mullions as required to meet loading requirements.
- F. Double weatherstrip operable units.
- G. Factory glaze window units.

### **2.07 FINISHES**

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick; dark bronze.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

### **3.02 INSTALLATION**

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

- D. Install sill and sill end angles.
- E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- F. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.
- G. Install operating hardware not pre-installed by manufacturer.

### **3.03 TOLERANCES**

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft (1.5 mm/m) non-cumulative or 1/8 inches per 10 ft (3 mm/3 m), whichever is less.

### **3.04 ADJUSTING**

- A. Adjust hardware for smooth operation and secure weathertight closure.

### **3.05 CLEANING**

- A. Remove protective material from factory finished aluminum surfaces.
- B. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

**END OF SECTION**

## SECTION 08630

### METAL-FRAMED SKYLIGHTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aluminum skylight framing system.
- B. Skylight glazing.
- C. Fasteners, anchors, reinforcement, and flashings.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05120 (05 1200) - Structural Steel: Structural support framing for system.
- B. Section 05500 (05 5000) - Metal Fabrications: Fabricated steel attachment devices.
- C. Section 06100 (06 1000) - Rough Carpentry: Wood support curbs.
- D. Section 07620 (07 6200) - Sheet Metal Flashing and Trim: Skylight counterflashing.
- E. Section 07900 (07 9005) - Joint Sealers.
- F. Section 08800 (08 8000) - Glazing.

##### 1.03 REFERENCE STANDARDS

- A. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2009.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- C. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- D. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- E. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- F. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- G. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- H. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- I. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- J. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a.
- K. ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005.
- L. ASTM D 4479 - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007.
- M. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.

- N. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.
- O. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Design and size components to withstand the following load requirements without damage or permanent set:
  - 1. Roof snow load: 8 lbf/sq ft (\_\_\_ Pa).
  - 2. Positive wind load: +5 lbf/sq ft (\_\_\_ Pa).
  - 3. Negative wind load: -22 lbf/sq ft (\_\_\_ Pa).
  - 4. Concentrated load at any location on framing: 250 lb (114 kg).
  - 5. Measure performance by testing in accordance with ASTM E 330, using test pressure equal to 1.5 times the design wind load and 10 second duration of maximum load.
- B. Maximum allowable deflection of any glazing support member: 1/180 of span.
- C. Design system to limit stress on structural glazing adhesive to 20 percent of tested tensile adhesion and maximum compression or elongation to 25 percent of neutral dimension.
- D. Design system to accommodate thermal expansion and contraction over ambient temperature range of 100 degrees F (56 degrees C), dynamic loading and release of loads, and deflection of structural support framing without damage to skylight system components or loss of weathertightness.
- E. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) for glazed area, measured at a reference differential pressure across assembly of 1.57 psf (75 Pa) in accordance with ASTM E 283.
- F. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 2.86 lbf/sq ft (140 Pa).
- G. Design and fabricate skylight system to prevent harmonic vibration, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

#### **1.05 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications, standard details, and installation requirements.
- C. Shop Drawings: Indicate framed opening requirements and tolerances, spacing of all members, anticipated deflection under load, affected related work, expansion and contraction joint locations and details, and sizes and locations for field welding.
  - 1. Show field measurements on shop drawings.
- D. Samples: Submit two samples, not less than 12 x 12 inch (300 x 300 mm) in size illustrating appearance of prefinished aluminum and specified glazing system, including glazed edge and corner.
- E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.
- F. Structural Glazing Adhesive: Submit product data and calculations showing compliance with performance requirements.

- G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- H. Report of field testing for water leakage.
- I. Manufacturer's Installation Instructions: Indicate special procedures, safety precautions, and perimeter conditions requiring special attention.

#### **1.06 QUALITY ASSURANCE**

- A. Designer Qualifications: Design skylight system under direct supervision of a professional structural engineer experienced in design of work of the type specified in this section and licensed in the state in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not fewer than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with not fewer than 3 years of experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Provide wrapping to protect prefinished aluminum surfaces. Do not use adhesive papers or spray coatings that bond when exposed to sunlight or weather.

#### **1.08 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work, including leaks, discoloration, failure of seal at insulated glazing units, and excessive thermal or structural movement, within a five year period after Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Metal-Framed Skylights:
  - 1. Bristolite Skylights: [www.bristolite.com](http://www.bristolite.com).
  - 2. The Vistawall Group: [www.naturalite.com](http://www.naturalite.com).
  - 3. Super Sky Products, Inc: [www.supersky.com](http://www.supersky.com).
  - 4. A.I.A Industries; Product Pyramid - Structural.
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

#### **2.02 METAL-FRAMED SKYLIGHTS**

- A. Metal Framed Skylights: Factory-fabricated, glazed.
  - 1. Frame: Extruded aluminum structural members with integral condensation collection and guttering system thermally separated from exterior pressure bar.
  - 2. Glazing System: Pressure glazing bar system for sloped joints and structural adhesive glazing for horizontal joints.
  - 3. Glazing: Insulating glass.
- B. Performance Requirements:
  - 1. Design and size components to withstand the following load requirements without damage or permanent set:
    - a. Roof snow load: 8 lbf/sq ft (\_\_\_ Pa).
    - b. Positive wind load: +5 lbf/sq ft (\_\_\_ Pa).
    - c. Negative wind load: -22 lbf/sq ft (\_\_\_ Pa).
    - d. Concentrated load at any location on framing: 250 lb (114 kg).

- e. Measure performance by testing in accordance with ASTM E 330, using test pressure equal to 1.5 times the design wind load and 10 second duration of maximum load.
- 2. Maximum allowable deflection of any glazing support member: 1/180 of span.
- 3. Design system to limit stress on structural glazing adhesive to 20 percent of tested tensile adhesion and maximum compression or elongation to 25 percent of neutral dimension.
- 4. Design system to accommodate thermal expansion and contraction over ambient temperature range of 100 degrees F (56 degrees C), dynamic loading and release of loads, creep of concrete structural members, and deflection of structural support framing without damage to skylight system components or loss of weathertightness.
- 5. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) for glazed area, measured at a reference differential pressure across assembly of 1.57 psf (75 Pa) in accordance with ASTM E 283.
- 6. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 2.86 lbf/sq ft (140 Pa).
- 7. Design and fabricate to prevent harmonic vibration, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

### **2.03 SKYLIGHT COMPONENTS**

- A. Frame: Extruded aluminum structural members with integral condensation collection and guttering system thermally separated from exterior pressure bar.
- B. Glazing System: Pressure glazing bar system for sloped joints and structural adhesive glazing for horizontal joints.
- C. Glazing: Insulating glass.

### **2.04 MATERIALS**

- A. Aluminum Extrusions: 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B 221 (ASTM B 221M). Minimum thickness 0.125 inch (3 mm) for structural members and 0.062 inch (1.5 mm) for non-structural members.
- B. Formed Aluminum: Sheet material of alloy 5052, 5005, or 6061-T651 complying with ASTM B 209 (ASTM B 209M). Minimum thickness: 0.125 inch for structural members and 0.062 inches (1.5 mm) for non-structural members.
- C. Internal Reinforcement: ASTM A 36/A 36M; Steel shapes as required for strength and mullion size limitations, hot-dip galvanized after fabrication in accordance with ASTM A 123/A 123M.
- D. Glass: Sealed insulated units, outer pane of tinted transparent, tempered glass; inner pane of clear transparent, laminated glass; space of sealed air, metal edge frame.
- E. Glazing Accessories: As recommended by manufacturer of skylight system.
- F. Structural Glazing Adhesive: Silicone, ASTM C 920, Class 25, Grade NS, neutral cure; maximum hardness of 40, when tested in accordance with ASTM D 2240 using Type A durometer; minimum tensile strength of 250 psi (1725 kPa), when tested in accordance with ASTM D 412.
- G. Weatherseal Sealant: Silicone, same type as glazing adhesive.
- H. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type.
- I. Protective Back Coating: Zinc molybdate alkyd.
- J. Fasteners: Stainless steel.

- K. Flashings: 0.063 inch (1.5 mm) thick aluminum, same finish as system components; secured with concealed fastening method.
- L. Anchorage Devices: Type recommended by manufacturer, exposed to view.

## **2.05 FABRICATION**

- A. Rigidly fit and secure joints and corners with screw and spline. Make joints rigid, with connections that are flush, hairline, and weatherproof.
- B. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.
- C. Drain to exterior any water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system.
- D. Prepare components to receive concealed anchorage devices. Ensure that fasteners and anchorage devices will be concealed upon completion of installation.
- E. Adhere glass to glazing frames with structural adhesive and cure under controlled conditions in shop. Field glazing of frames to glass is not acceptable.

## **2.06 FINISHES**

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick; dark bronze; both interior and exterior surfaces.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that structural curb is ready to receive skylight system. Coordinate installation of roofing and other adjacent work to ensure weathertight construction.

### **3.02 PREPARATION**

- A. Apply 1 coat of protective coating to concealed aluminum and steel surfaces in contact with dissimilar materials.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Set skylight structure plumb, level, and true to line, without warp or rack of frames or glazing panels. Anchor securely in place in accordance with approved shop drawings.
- C. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Install sill flashings.
- E. Touch up damaged finishes so repair is imperceptible from 6 feet (2 meters). Remove and replace components that cannot be satisfactorily touched up.

### **3.04 TOLERANCES**

- A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet (1 mm/m), or 3/8 inch (10 mm) total in overall dimension.
- B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inches (1.6 mm).

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for testing and inspection.
- B. Test installed skylight for water leakage in accordance with AAMA 501.2.

### **3.06 CLEANING**

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces; wipe surfaces clean.
- C. Remove excess sealant by methods recommended by skylight manufacturer.

**END OF SECTION**

## SECTION 08710

### DOOR HARDWARE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Hardware for wood, hollow steel, and aluminum doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors for which hardware is specified in other sections.
- E. Thresholds.
- F. Weatherstripping, seals and door gaskets.
- G. Gate locks.

##### 1.02 RELATED REQUIREMENTS

- A. Section 08110 (08 1113) - Steel Doors and Frames.
- B. Section 08211 (08 1416) - Flush Wood Doors.
- C. Section 08212 (08 1433) - Stile and Rail Wood Doors.
- D. Section 08460 (08 4229) - Automatic Entrance Doors: Hardware for same.
- E. Section 10441 (10 1424) - Plastic Signs.
- F. Section: Power supply to electric hardware devices.
- G. Section 13704 (28 1300) - Security Access System : Electronic access control devices.

##### 1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01210 (01 2100) - Allowances, for allowances affecting this section.

##### 1.04 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.2).
- C. BHMA A156.3 - American National Standard for Exit Devices; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.3).
- D. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.4).
- E. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.6).
- F. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2005 (ANSI/BHMA A156.8).
- G. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; Builders Hardware Manufacturers Association; 2006 (ANSI/BHMA A156.15).

- H. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).
- I. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.22).
- J. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators (ANSI/BHMA A156.31).
- K. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.
- L. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2010.
- N. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2009.
- O. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

#### **1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### **1.06 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
  - 2. Submit manufacturer's parts lists and templates.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- D. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- F. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.
  - 2. Extra Lock Cylinders: Ten for each master keyed group.

3. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.
4. Provide owner with two (2) additional lever lock sets found in Hardware set no. 2 and key the same for future use.

#### **1.07 QUALITY ASSURANCE**

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- C. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 5 years of experience.
- D. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

#### **1.09 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for door closers.
- C. Provide two year warranty against failure of parts for all other hardware.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

#### **2.02 DOOR HARDWARE - GENERAL**

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide all items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
  1. Applicable provisions of federal, state, and local codes.
  2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  3. Applicable provisions of NFPA 101, Life Safety Code.
  4. Fire-Rated Doors: NFPA 80.
  5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
  6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
  7. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- D. Electrically Operated and/or Controlled Hardware: Provide all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide wiring between hardware and control components and to building power connection.

- E. Finishes: All door hardware the same finish unless otherwise indicated.
1. Primary Finish: Oil Rubbed Bronze, US10B, 613.
  2. Finish Definitions: BHMA A156.18.
  3. Exceptions:
    - a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
    - b. Hinges for Fire-Rated Doors: Steel base metal with plated finish.
    - c. Door Closer Covers and Arms: Color to be selected by Architect from manufacturer's standard colors.
    - d. Aluminum Surface Trim and Gasket Housings: Anodized to match door, not to match other hardware.

### 2.03 HINGES

- A. Hinges: Provide hinges on every swinging door.
1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
  2. Provide ball-bearing hinges at all doors having closers.
  3. Provide hinges in the quantities indicated.
  4. Provide non-removable pins on exterior outswinging doors.
  5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
- B. Quantity of Hinges Per Door:
1. Doors up to 60 inches (1.5 m) High: Two hinges.
  2. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
  3. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.
  4. Doors over 120 inches (3 m) High: One additional hinge per each additional 30 inches (762 mm) in height.
- C. Manufacturers - Hinges:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Bommer Industries, Inc: [www.bommer.com](http://www.bommer.com).
  3. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  4. Stanley Hardware: [www.stanleyworks.com](http://www.stanleyworks.com).
  5. Substitutions: See Section 01600 (01 600J) - Product Requirements.

### 2.04 PUSH/PULLS

- A. Push/Pulls: Comply with BHMA A156.6.
1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
  2. On solid doors, provide matching push plate and pull plate on opposite faces.
  3. On glazed storefront doors, provide matching push/pull bars on both faces.

### 2.05 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
1. Hardware Sets indicate locking functions required for each door.
  2. If no hardware set is indicated for a swinging door provide an office lockset.
  3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
  4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Electrically Operated Locks: Fail secure unless otherwise indicated.
- C. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
1. Provide cams and/or tailpieces as required for locking devices required.

- D. Keying: Grand master keyed.
  - 1. When providing keying information, comply with DHI Handbook "Keying systems and nomenclature".
- E. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

## **2.06 CYLINDRICAL LOCKSETS**

- A. Locking Functions: As defined in BHMA A156.2, and as follows:
  - 1. Passage: No locking, always free entry and exit.
  - 2. Privacy: F76, emergency tool unlocks.
  - 3. Office: F82 Grade 1, key not required to lock, unlocks upon exit.
- B. Manufacturers - Cylindrical Locksets:
  - 1. Assa Abloy Corbin Russwin, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Best Access Systems, division of Stanley Security Solutions: [www.bestlock.com](http://www.bestlock.com).
  - 3. Hager Companies: [www.hagercom.com](http://www.hagercom.com).
  - 4. Schlage: [www.schlage.com](http://www.schlage.com).
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.07 MAGNETIC LOCKS**

- A. Magnetic Locks:
- B. Manufacturers:
  - 1. Assa Abloy Securitron: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.08 ELECTRIC STRIKES**

- A. Electric Strikes: Complying with BHMA A156.31 and UL listed as a Burglary-Resistant Electric Door Strike; style to suit locks.
- B. Manufacturers:
  - 1. Assa Abloy Folger Adam EDC, HES, or Securitron: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.09 EXIT DEVICES**

- A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
  - 1. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.
- B. Manufacturers:
  - 1. Assa Abloy Corbin Russwin, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. DORMA Group North America: [www.dorma-usa.com/usa](http://www.dorma-usa.com/usa).
  - 3. Hager Companies: [www.hagercom.com](http://www.hagercom.com).
  - 4. Von Duprin: [www.vonduprin.com](http://www.vonduprin.com).
  - 5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.10 CLOSERS**

- A. Closers: Complying with BHMA A156.4.
  - 1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
  - 2. Provide a door closer on every exterior door.
  - 3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
  - 4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.

B. Manufacturers - Closers:

1. Assa Abloy Corbin Russwin, Norton, Rixson, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
2. DORMA Group North America: [www.dorma-usa.com/usa](http://www.dorma-usa.com/usa).
3. Hager Companies: [www.hagercom.com](http://www.hagercom.com).
4. LCN: [www.lcnclosers.com](http://www.lcnclosers.com).
5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## 2.11 STOPS AND HOLDERS

- A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
1. Provide wall stops, unless otherwise indicated.
  2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
  3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.
- B. Magnetic Holder/Releases: Complying with BHMA A156.15; fail safe; doors release to close automatically when electrical current is interrupted; holding force: 25 to 40 pounds-force (111 to 177 N).
- C. Manufacturers - Overhead Holders/Stops:
1. Assa Abloy Rixson or Sargent: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. DORMA Group North America: [www.dorma-usa.com/usa](http://www.dorma-usa.com/usa).
  3. Glynn-Johnson: [www.glynn-johnson.com](http://www.glynn-johnson.com).
  4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- D. Manufacturers - Wall and Floor Stops/holders:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  3. Hiawatha, Inc: [www.hiawathainc.com](http://www.hiawathainc.com).
  4. Triangle Brass Manufacturing Co., Inc: [www.trimcobbw.com](http://www.trimcobbw.com).
  5. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- E. Manufacturers - Magnetic Holder/Releases:
1. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  2. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## 2.12 GASKETING AND THRESHOLDS

- A. Gaskets: Complying with BHMA A156.22.
1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
  2. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
    - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
  3. On each exterior door, provide door bottom sweep, unless otherwise indicated.
- B. Thresholds:
1. At each exterior door, provide a threshold unless otherwise indicated.
  2. Field cut threshold to frame for tight fit.
- C. Fasteners At Exterior Locations: Non-corroding.
- D. Manufacturers - Gasketing and Thresholds:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).

2. Hager Companies: [www.hagercom.com](http://www.hagercom.com).
3. National Guard Products, Inc: [www.ngpinc.com](http://www.ngpinc.com).
4. Pemko Manufacturing Co: [www.pemko.com](http://www.pemko.com).
5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.13 SLIDING AND BIFOLDING DOOR HARDWARE**

- A. Bypassing Door Hardware: Track, hanger fasteners, guides, and pulls; size track and hangers according to manufacturer's recommendations for weight of doors.
  1. Provide flush cup pull on each sliding panel.
- B. Manufacturers - Sliding and Bifolding Hardware:
  1. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  2. Johnson Hardware: [www.johnsonhardware.com](http://www.johnsonhardware.com).
  3. Stanley Hardware: [www.stanleyworks.com](http://www.stanleyworks.com).
  4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.14 PROTECTION PLATES AND ARCHITECTURAL TRIM**

- A. Protection Plates:
- B. Manufacturers - Protection Plates and Architectural Trim:
  1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  3. Hiawatha, Inc: [www.hiawathainc.com](http://www.hiawathainc.com).
  4. Triangle Brass Manufacturing Co., Inc: [www.trimcobbw.com](http://www.trimcobbw.com).
  5. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.15 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS**

- A. Provide products that comply with the following:
  1. Applicable provisions of Federal, State, and local codes.
  2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  3. Applicable provisions of NFPA 101, Life Safety Code.
  4. Fire-Rated Doors: NFPA 80.
  5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
  6. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Finishes: Identified in schedule at end of section.

### **2.16 KEYING**

- A. Door Locks: Grand master keyed.
- B. Supply keys in the following quantities:
  1. 5 master keys.
  2. 5 grand master keys.
  3. 3 change keys for each lock.

### **2.17 KEY CABINET**

- A. Cabinet Construction: Sheet steel construction, piano hinged door with cylindrical type lock.[<>].
- B. Cabinet Size: Size for project keys plus 10 percent growth.
- C. Horizontal metal strips for key hook labelling with clear plastic strip cover over labels.

- D. Finish: Baked enamel, color as selected.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

#### **3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Do not install surface mounted items until finishes applied to substrate are complete.
- D. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- E. Mounting heights for hardware from finished floor to center line of hardware item:
  - 1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."
  - 2. For wood doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."

#### **3.03 FIELD QUALITY CONTROL**

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

#### **3.04 ADJUSTING**

- A. Adjust work under provisions of Section 01700 (01 7000).
- B. Adjust hardware for smooth operation.

#### **3.05 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

#### **3.06 PROTECTION**

- A. Protect finished Work under provisions of Section 01700 (01 7000).
- B. Do not permit adjacent work to damage hardware or finish.

**END OF SECTION**

## SECTION 08800

### GLAZING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 08830 (08 8300) - Mirrors.

##### 1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- D. ASTM C 1036 - Standard Specification for Flat Glass; 2006.
- E. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2004.
- F. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; 2003.
- G. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2009.
- H. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2008.
- I. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- J. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 2008.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12 x 12 inch (304.8 x 304.8 mm) in size of glass units, showing coloration and design.
- E. Samples: Submit 12 inch (304.8 mm) long bead of glazing sealant, color as selected.
- F. Certificates: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Certificate: Certify that glass meets or exceeds specified requirements.

##### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

## 1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## 1.07 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

## PART 2 PRODUCTS

### 2.01 GLAZING TYPES

- A. Type IG-1 - Sealed Insulating Glass Units: Vision glazing, low-E.
  - 1. Application(s): All exterior glazing unless otherwise indicated.
  - 2. Substitutions: Refer to Section 01600 (01 6000) - Product Requirements.
    - a. Other products of the basis of design manufacturer and products of other manufacturers will be considered provided the overall performance is within the specified range(s) and the overall appearance is not significantly different from that of the specified product.
  - 3. Between-lite space filled with air.
  - 4. Basis of Design: Guardian Industries Corp: [www.sunguardglass.com](http://www.sunguardglass.com).
  - 5. Outboard Lite: Annealed float glass, 1/4 inch (6 mm) thick, minimum.
    - a. Tint and Coating: Guardian CrystalGray with Guardian SuperNeutral 54 on #2 surface.
  - 6. Inboard Lite: Annealed float glass, 1/4 inch (6 mm) thick.
    - a. Tint: None (clear).
  - 7. Total Thickness: 1 inch (25 mm).
  - 8. Total Visible Light Transmittance: 39 percent, exactly.
  - 9. Total Solar Heat Gain Coefficient: .23 percent, exactly.
- B. Type IG-3 - Sealed Insulating Glass Units: Safety glazing:
  - 1. Applications: Provide this type of glazing in the following locations:
    - a. Glazed lites in exterior doors.
    - b. Glazed sidelights and panels next to doors.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations indicated on the drawings.
  - 2. Type: Same as Type IG-1 except use fully tempered float glass for both outboard and inboard lites.
  - 3. Tint: Same as Type IG-1.
- C. Type IG-4 - Sealed Insulating Glass Units: Safety glazing:
  - 1. Applications: Provide this type of glazing in the following locations:
    - a. Glazed skylights.
  - 2. Type: Same as Type IG-1 except use fully tempered float glass for outboard lite and heat strengthened laminated glass for the inboard lite.
  - 3. Tint: Same as Type IG-1.

- D. Type S-1 - Single Vision Glazing:
  - 1. Applications: All interior glazing unless otherwise indicated.
  - 2. Type: Fully tempered float glass.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch (6 mm).
  - 5. Glazing Method: Wood stops with tape.
- E. Type S-3 - Single Safety Glazing: Non-fire-rated.
  - 1. Applications: Provide this type of glazing in the following locations:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations indicated on the drawings.
  - 2. Type: Fully tempered float glass as specified.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch (6 mm).

## 2.02 GLASS MATERIALS

- A. Float Glass Manufacturers:
  - 1. Guardian Industries Corp: [www.sunguardglass.com](http://www.sunguardglass.com).
  - 2. Pilkington North America Inc: [www.pilkington.com](http://www.pilkington.com).
  - 3. PPG Industries, Inc: [www.ppg.com](http://www.ppg.com).
  - 4. Substitutions: Refer to Section 01600 (01 6000) - Product Requirements.
- B. Float Glass: All glazing is to be float glass unless otherwise indicated.
  - 1. Annealed Type: ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  - 2. Heat-Strengthened and Fully Tempered Types: ASTM C 1048.
  - 3. Tinted Types: Color and performance characteristics as indicated.
  - 4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C 1172.
  - 1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
  - 2. Plastic Interlayer: 0.060 inch (1.52 mm) thick, minimum.
  - 3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.
- D. Clear Float Glass (Type 1): Clear, annealed.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  - 2. 6 mm minimum thick.
- E. Safety Glass (Type 2): Clear; fully tempered with horizontal tempering.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
  - 2. Comply with 16 CFR 1201 test requirements for Category II.
  - 3. 6 mm minimum thick.
  - 4. Provide this type of glazing in the locations required by code.
    - a. Glazed lites in doors except fire doors.
    - b. Glazed sidelights to doors.
- F. Tinted Glass (Type 3): Float type, heat strengthened, grey color.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 2, Quality Q3 (glazing select).
  - 2. Comply with ASTM C 1048.
  - 3. 6 mm minimum thick.

- G. One-Way Reflective Mirror Glass (Type 4): Clear, float type.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q2.
  - 2. 6 mm minimum thick.
  - 3. Sizes indicated on drawings.
- H. Low E Glass (Type 5): Float type, heat strengthened, in grey color.
  - 1. Coating on inner surface.
  - 2. Visible light transmittance of 39 percent, solar light transmittance of 17 percent, shading coefficient of .23.
  - 3. Comply with ASTM C 1036, Type I, transparent flat, Quality Q3 (glazing select).
  - 4. 6 mm minimum thick.

### **2.03 SEALED INSULATING GLASS UNITS**

- A. Manufacturers:
  - 1. Guardian Industries Corp: [www.guardian.com](http://www.guardian.com).
  - 2. Substitutions: Refer to Section 01600 (01 6000) - Product Requirements.
- B. Sealed Insulating Glass Units: Types as indicated.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
  - 2. Edge Spacers: Aluminum, bent and soldered corners.
  - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
  - 4. Purge interpane space with dry hermetic air.
- C. Insulated Glass Units (Type IG-1, IG-3): Double pane with glass to elastomer edge seal.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
  - 2. Purge interpane space with dry hermetic air.

### **2.04 GLAZING COMPOUNDS**

- A. Manufacturers:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 4. Substitutions: Refer to Section 01600 (01 6000) - Product Requirements.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

### **2.05 GLAZING ACCESSORIES**

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; sized as required for proper glazing installation; black color.
  - 1. Manufacturers:
    - a. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - b. Substitutions: Refer to Section 01600 (01 6000) - Product Requirements.

- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; black color.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

#### **3.02 PREPARATION**

- A. Prime surfaces scheduled to receive sealant.
- B. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.
- C. Install sealant in accordance with manufacturer's instructions.

#### **3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)**

- A. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

#### **3.04 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)**

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (600 mm) intervals, 1/4 inch (6 mm) below sight line.
- C. Fill gaps between glazing and stops with window manufacturer approved type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

#### **3.05 MANUFACTURER'S FIELD SERVICES**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

#### **3.06 CLEANING**

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

#### **3.07 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

**END OF SECTION**



## SECTION 08830

### MIRRORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Glass mirrors.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06200 (06 2000) - Finish Carpentry: Wood frames for mirrors.

##### 1.03 REFERENCE STANDARDS

- A. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- B. GANA (TIPS) - Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors; National Association of Mirror Manufacturers; 2004 (<http://www.mirrorlink.org/members/technical.htm>).

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.

##### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS) "Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors."

##### 1.06 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

##### 1.07 WARRANTY

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Mirrors:
  - 1. Arch Aluminum & Glass Co., Inc: [www.arch.amarlite.com](http://www.arch.amarlite.com).
  - 2. Binswanger Mirror/ACI Distribution: [www.binswangermirror.com](http://www.binswangermirror.com).

3. Lenoir Mirror Co: [www.lenoirmirror.com](http://www.lenoirmirror.com).
4. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.02 MATERIALS**

- A. Mirror Glass - General: Select materials and/or provide supports as required to limit mirrored glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.
- B. Mirror Glass (Type M-1): Clear float type with copper and silver coating, organic overcoating, arrised edges, 6.4 mm thick minimum.
  1. Sizes noted on Drawings.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

### **3.02 INSTALLATION - GENERAL**

- A. Install mirrors in accordance with GANA recommendations.
- B. Set mirrors plumb and level, free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Installation in Frames:
  1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
  2. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
  3. Rest mirrors on setting blocks and push against tape for full contact at perimeter of pane or unit.
  4. Place glazing tape on free perimeter of mirrors in same manner described above.
  5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
  6. Knife trim protruding tape.
- E. Frameless Mirrors: Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.

### **3.03 CLEANING**

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

**END OF SECTION**

## SECTION 09206

### METAL LATH

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Metal lath for Portland cement and gypsum plaster.

##### 1.02 RELATED REQUIREMENTS

- A. Section 07260 - Weather Barriers: Weather barrier under exterior plaster and stucco.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 847 - Standard Specification for Metal Lath; 2006.
- B. ASTM C 1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Metal Lath:
  1. Clark Western Building Systems: [www.clarkwestern.com](http://www.clarkwestern.com).
  2. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  3. Substitutions: See Section 01600 - Product Requirements.

##### 2.02 FRAMING MATERIALS

- A. Resilient Channels: Formed steel, minimum 0.020 inch (0.5 mm) thick; serrated face, hat shaped profile, 2 1/2 inch (63.5 mm) wide, splicing permitted; galvanized.

##### 2.03 LATH

- A. Diamond Mesh Metal Lath: ASTM C 847, galvanized; self-furring.
- B. Corner Mesh: Formed sheet steel, minimum 0.018 inch (0.5 mm) thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch (50 mm) size; same finish as lath.
- C. Strip Mesh: Expanded metal lath, same weight as lath, 6 inch (152 mm) wide x 24 inch (600 mm) long; same finish as lath.
- D. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, maximum possible lengths.
  1. Material: Formed galvanized sheet steel, expanded metal flanges.
  2. Casing Beads: Square edges.
  3. Corner Beads: Radiused corners.
  4. Base Screeds: Bevelled edges.
  5. Expansion Joints: Accordion profile with factory-installed protective tape, 2 inch (50 mm) wide flanges.

6. Control Joints: Accordion profile with protective tape, 2 inch (50 mm) flanges.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. For exterior plaster and stucco on stud walls, verify that weather barrier has been installed over sheathing substrate completely and correctly.
- D. Do not begin until unacceptable conditions have been corrected.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 INSTALLATION - GENERAL**

- A. Install interior lath and furring in accordance with ASTM C 841.
- B. Install lath and furring for Portland cement plaster in accordance with ASTM C 1063.

#### **3.03 WALL FURRING**

- A. Install furring channels horizontally; secure with fasteners on alternate channel flanges at maximum 24 inches (600 mm) on center.
- B. Space furring channels maximum 16 inches (400 mm) on center, and not more than 4 inches (100 mm) away from floor and ceiling lines.
- C. Space resilient channels at maximum 24 inches (600 mm) on center. Place joints over framing members.

#### **3.04 CEILING AND SOFFIT FRAMING**

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening.
- H. Laterally brace suspension system.

#### **3.05 CONTROL AND EXPANSION JOINTS**

- A. Install control and expansion joints.

#### **3.06 ACCESS PANELS**

- A. Install access panels and rigidly secure in place.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position to provide convenient access to concealed work requiring access.

### **3.07 LATH INSTALLATION**

- A. Apply metal lath taut, with long dimension perpendicular to supports.
- B. Lap ends minimum 1 inch (25 mm). Secure end laps with tie wire where they occur between supports.
- C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches (75 mm) from corner to form the angle reinforcement; fasten at perimeter edges only.
- D. Place corner bead at external wall corners; fasten at outer edges of lath only.
- E. Place base screeds at termination of plaster areas; secure rigidly in place.
- F. Place 4 inch (100 mm) wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.
- G. Place lath vertically above each top corner and each side of door frames to 6 inches (150 mm) above ceiling line.
- H. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- I. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

**END OF SECTION**



## SECTION 09220

### PORTLAND CEMENT PLASTER

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Portland cement plaster for installation over metal lath, masonry, concrete, and solid surfaces.

##### 1.02 RELATED REQUIREMENTS

- A. Section 09206 - Metal Lath: Metal furring and lathing for plaster.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 926 - Standard Specification for Application of Portland Cement-Based Plaster; 2006.
- B. ASTM C 932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data on plaster materials, characteristics and limitations of products specified.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section and approved by manufacturer.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

##### 1.06 MOCK-UP

- A. Construct mock-up of exterior wall, 10 feet (3.0 m) long by 10 feet (3.0 m) wide, illustrating surface finish.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

##### 1.07 FIELD CONDITIONS

- A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F (10 degrees C) or over 80 degrees F (27 degrees C).
- B. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) during installation of plaster and until cured.

#### PART 2 PRODUCTS

##### 2.01 PLASTER MATERIALS

- A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C 926.
- B. Premixed Finish Coat: Color and Texture type; Tuscan Glaze - #800 Metropolitan over Sunset Yellow #107 color; Freestyle Finish manufactured by Dryvit.
- C. Bonding Agent: ASTM C 932; type recommended for bonding plaster to concrete and concrete masonry surfaces.

## **2.02 METAL LATH**

- A. Metal Lath and Accessories: As specified in Section 09206.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09206.

## **2.03 PLASTER MIXES**

- A. Over Solid Bases: Three-coat application, mixed and proportioned in accordance with ASTM C 926.
- B. Over Metal Lath: Three-coat application, mixed and proportioned in accordance with ASTM C 926.
- C. Mix only as much plaster as can be used prior to initial set.
- D. Mix materials dry, to uniform color and consistency, before adding water.
- E. Protect mixtures from freezing, frost, contamination, and excessive evaporation.
- F. Do not retemper mixes after initial set has occurred.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify the suitability of existing conditions before starting work.
- B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.
- C. Concrete: Verify surfaces are flat, honeycomb are filled flush, and surfaces are ready to receive work of this section. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to plaster bond.
- D. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

### **3.02 PREPARATION**

- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean concrete surfaces of foreign matter. Clean surfaces using acid solutions, solvents, or detergents. Wash surfaces with clean water.
- C. Roughen smooth concrete surfaces and apply bonding agent in accordance with manufacturer's instructions.

### **3.03 PLASTERING**

- A. Apply premixed plaster in accordance with manufacturer's instructions.
- B. Apply plaster in accordance with ASTM C 926.
- C. Three-Coat Application Over Metal Lath:
  - 1. Apply first coat to a nominal thickness of 3/8 inch (9 mm).
  - 2. Apply second coat to a nominal thickness of 3/8 inch (9 mm).
  - 3. Apply finish coat to a nominal thickness of 1/8 inch (3 mm).
- D. Three-Coat Application Over Solid Bases:
  - 1. Apply first coat to a nominal thickness of 1/4 inch (6 mm).
  - 2. Apply second coat to a nominal thickness of 1/4 inch (6 mm).
  - 3. Apply finish coat to a nominal thickness of 1/8 inch (3 mm).

- E. In exterior work, scribe contraction joints through entire plaster application at 10 feet (3 m) on center each way.
- F. Moist cure base coats.
- G. Apply second coat immediately following initial set of first coat.
- H. After curing, dampen previous coat prior to applying finish coat.
- I. Finish Texture: Freestyle to a consistent finish.
- J. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
- K. Moist cure finish coat for minimum period of 48 hours.

#### **3.04 TOLERANCES**

- A. Maximum Variation from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m).

**END OF SECTION**



## SECTION 09260

### GYPSUM BOARD ASSEMBLIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Textured finish system.
- I. Water-resistive barrier over exterior wall sheathing.

##### 1.02 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 1999 (R2005).
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (R2005).
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009.
- E. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- F. ASTM C 557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003.
- G. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members; 2007.
- H. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2006.
- I. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2007.
- J. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2007.
- K. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2007.
- L. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.

- M. ASTM C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2005.
- N. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2006.
- O. ASTM C 1280 - Standard Specification for Application of Gypsum Sheathing; 2007.
- P. ASTM C 1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 1999 (Reapproved 2004).
- Q. ASTM C 1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2004.
- R. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2006a.
- S. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2000 (Reapproved 2005).
- T. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; 2005.
- U. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2007.

### **1.03 SUBMITTALS**

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Test Reports: For all stud framing products that do not comply with ASTM C 645 or C 754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- E. Samples: Submit two samples of gypsum board finished with proposed texture application, 60 inches (1524 mm) square in size, illustrating finish color and texture.

### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.

## **PART 2 PRODUCTS**

### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C 840 and GA-216.

### **2.02 METAL FRAMING MATERIALS**

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
  1. Clark Western Building Systems: [www.clarkwestern.com](http://www.clarkwestern.com).
  2. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  3. Substitutions: See Section 01600 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (240 Pa).

1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi (275 MPa) minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C 754.
  - a. Acceptable Products:
    - 1) Dietrich Metal Framing; UltraSteel (tm): [www.dietrichindustries.com](http://www.dietrichindustries.com).
    - 2) Clark Western Building Systems; UltraSteel (tm): [www.clarkwestern.com](http://www.clarkwestern.com).
  2. Studs: "C" shaped with flat or formed webs with knurled faces.
  3. Runners: U shaped, sized to match studs.
  4. Ceiling Channels: C shaped.
  5. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
  6. Resilient Furring Channels: 1/2 inch (12 mm) depth, for attachment to substrate through one leg only.
- C. Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  2. Material: ASTM A 653/A 653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.

### 2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  1. American Gypsum: [www.americangypsum.com](http://www.americangypsum.com).
  2. Georgia-Pacific Gypsum LLC: [www.gp.com/gypsum](http://www.gp.com/gypsum).
  3. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  4. USG Corporation: [www.usg.com](http://www.usg.com).
  5. Substitutions: See Section 01600 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
  1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
    - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
  3. Thickness:
    - a. Vertical Surfaces: 5/8 inch (16 mm).
    - b. Ceilings: 5/8 inch (16 mm).
    - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
  4. Mold-Resistant Paper-Faced Products:
    - a. American Gypsum; M-Bloc.
    - b. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
    - c. National Gypsum Company; Gold Bond Hi-Abuse Brand XP Wallboard.
    - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
    - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels AR.
    - f. Substitutions: See Section 01600 - Product Requirements.
- C. Backing Board For Wet Areas: One of the following products:
  1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and

- shower ceilings.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
  3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C 1325.
    - a. Thickness: 1/2 inch (12.7 mm).
    - b. Products:
      - 1) Custom Building Products; Wonderboard.
      - 2) National Gypsum Company; PermaBase Brand Cement Board.
      - 3) National Gypsum Company; PermaBase Flex Brand Cement Board.
      - 4) USG Corporation; Durock Brand Cement Board.
      - 5) Substitutions: See Section 01600 - Product Requirements.
  4. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C 1288.
    - a. Thickness: 1/2 inch (12.7 mm).
    - b. Products:
      - 1) James Hardie Building Products, Inc; Hardibacker Cement Board.
      - 2) Substitutions: See Section 01600 - Product Requirements.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C 1396/C 1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
  2. Type: Regular and Type X, in locations indicated.
  3. Type X Thickness: 5/8 inch (16 mm).
  4. Regular Board Thickness: 5/8 inch (16 mm).
  5. Edges: Tapered.
  6. Products:
    - a. American Gypsum; AquaBloc ("Greenboard").
    - b. CertainTeed Corporation; ProRoc Brand Moisture Resistant Gypsum Board ("Greenboard").
    - c. Georgia-Pacific Gypsum LLC; ToughRock Moisture-Guard Gypsum Board ("Greenboard").
    - d. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
    - e. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
    - f. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
    - g. Substitutions: See Section 01600 - Product Requirements.
- E. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
  2. Thickness: 1/2 inch (13 mm).
  3. Edges: Tapered.
  4. Products:
    - a. American Gypsum; Interior Ceiling Board.
    - b. Georgia-Pacific Gypsum LLC; ToughRock CD Ceiling Board.
    - c. National Gypsum Company; High Strength Brand Ceiling Board.
    - d. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
- F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
  2. Glass-Mat-Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C 1177/C 1177M.
  3. Unfaced Sheathing: Water-resistant exterior fiber-reinforced gypsum sheathing panels as defined in ASTM C 1278/C 1278M, and exceeding the relevant requirements of ASTM C 1177/C 1177M.

4. Core Type: Type X.
5. Type X Thickness: 5/8 inch (16 mm).
6. Edges: Square, for vertical application.
7. Glass-Mat-Faced Products:
  - a. Substitutions: See Section 01600 - Product Requirements.
8. Unfaced Products:
  - a. Substitutions: See Section 01600 - Product Requirements.

## **2.04 ACCESSORIES**

- A. Acoustic Insulation: ASTM C 665; preformed glass fiber, friction fit type, unfaced.
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
  1. Product: Acoustic Sealant manufactured by Sheetrock.
- C. Water-Resistive Barrier: No. 15 asphalt felt.
- D. Finishing Accessories: ASTM C 1047, galvanized steel or rolled zinc, unless otherwise indicated.
  1. Types: As detailed or required for finished appearance.
- E. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
- F. Textured Finish Materials: Latex-based compound; plain.
- G. Screws for Attachment to Steel Members Less Than 0.03 inch (0.7 mm) In Thickness, to Wood Members, and to Gypsum Board: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- H. Screws for Attachment to Steel Members From 0.033 to 0.112 inch (0.8 to 2.8 mm) in Thickness: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- I. Adhesive for Attachment to Wood: ASTM C 557.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

### **3.02 FRAMING INSTALLATION**

- A. Metal Framing: Install in accordance with ASTM C 754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  1. Level ceiling system to a tolerance of 1/1200.
- C. Studs: Space studs as permitted by standard.
  1. Extend partition framing to structure where indicated and to ceiling in other locations.
  2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

- E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

### **3.04 BOARD INSTALLATION**

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Exterior Sheathing: Comply with ASTM C 1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
  - 1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- E. Cementitious Backing Board: Install over steel framing members and wood framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- F. Installation on Metal Framing: Use screws for attachment of all gypsum board.
- G. Installation on Wood Framing: For non-rated assemblies, install as follows:
  - 1. Single-Layer Applications: Adhesive application.
  - 2. Double-Layer Application: Install base layer using screws. Install face layer using screws.
- H. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.

### **3.06 JOINT TREATMENT**

- A. Finish gypsum board in accordance with levels defined in ASTM C 840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to

receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### **3.07 TEXTURE FINISH**

A. Apply finish texture coating by means of trowel in accordance with manufacturer's instructions and to match approved sample.

### **3.08 TOLERANCES**

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

**END OF SECTION**



## SECTION 09300

### TILE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Ceramic accessories.
- F. Ceramic trim.
- G. Non-ceramic trim.

##### 1.02 RELATED REQUIREMENTS

- A. Section 07900 - Joint Sealers.
- B. Section 15410 - Plumbing Fixtures: Shower receptor.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2005.
  - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2005.
  - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 1999 (R2005).
  - 5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (R2005).
  - 6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (R2005).
  - 7. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (R2005).
  - 8. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (R2005).
  - 9. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (R2005).
  - 10. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 1999 (R2005).
  - 11. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar; 1999 (R2005).
  - 12. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar; 1999 (R2005).
  - 13. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (R2005).

14. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 1999 (R2005).
  15. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2008.
- B. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; 2007/2008.

#### **1.04 SUBMITTALS**

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches (450 x 450 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01600 - Product Requirements, for additional provisions.
  2. Extra Tile: 3 percent percent of each size, color, and surface finish combination.

#### **1.05 QUALITY ASSURANCE**

- A. Maintain one copy of TCA Handbook and ANSI A108 Series/A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

#### **1.06 MOCK-UP**

- A. See Section 01400 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on the drawings, incorporating all components specified for the location.
  1. Minimum size of mock-up is indicated on the drawings.
  2. Approved mock-up may remain as part of the Work.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.08 FIELD CONDITIONS**

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

### **PART 2 PRODUCTS**

#### **2.01 TILE**

- A. Manufacturers: All products of each type by the same manufacturer.
  - 1. American Olean: [www.americanolean.com](http://www.americanolean.com).
  - 2. Substitutions: See Section 01600 - Product Requirements.
- B. Glazed Wall Tile: ANSI A137.1, and as follows:
  - 1. Colors: As shown on the drawings.
- C. Paver Tile: ANSI A137.1, and as follows:
  - 1. Colors: As shown on the drawings.

## **2.02 TRIM AND ACCESSORIES**

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Applications: Use in the following locations:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Jointed.
    - c. Floor to Wall Joints: Cove base.
  - 2. Manufacturer: Same as for tile.
- C. Non-Ceramic Trim: anodized extruded aluminum, color to be selected from manuf. standard colors, style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications: Use in the following locations:
    - a. Wall corners, outside and inside.
    - b. Transition between floor finishes of different heights.
    - c. Expansion and control joints, floor and wall.
    - d. Floor to wall joints.
    - e. Borders and other trim as indicated on drawings.
  - 2. Manufacturer:
    - a. Schluter-Systems: [www.schluter.com](http://www.schluter.com).
    - b. Substitutions: See Section 01600 - Product Requirements.

## **2.03 ADHESIVE MATERIALS**

- A. Manufacturers:
  - 1. Substitutions: See Section 01600 - Product Requirements.

## **2.04 MORTAR MATERIALS**

- A. Manufacturers:
  - 1. Substitutions: See Section 01600 - Product Requirements.
- B. Mortar Bed Materials: Portland cement, sand, latex additive and water.
- C. Mortar Bond Coat Materials:
  - 1. Dry-Set Portland Cement type: ANSI A118.1.
  - 2. Latex-Portland Cement type: ANSI A118.4.

## **2.05 GROUT MATERIALS**

- A. Manufacturers:
  - 1. Mapei.
  - 2. Substitutions: See Section 01600 - Product Requirements.

## 2.06 ACCESSORY MATERIALS

- A. Uncoupling Membrane: 1/8 inch (3 mm) thick polyurethane matting with three-dimensional grid structure with dovetail shaped cavities and fleece webbing laminated to the underside to provide a mechanical bond to the substrate adhesive (DITRA).
  - 1. Acceptable Product: Schluter Systems "DITRA."
- B. Waterproofing Membrane at Showers and Tiled Tubs: PVC sheet membrane, 40 mils (1 mm) thick, minimum; specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
- C. Membrane at Walls: No. 15 (6.9 kg) asphalt saturated felt.
- D. Reinforcing Mesh: 2 x 2 inch (50 x 50 mm) size weave of 16/16 wire size; welded fabric, galvanized.
- E. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch (13 mm) thick; 2 inch (50 mm) wide coated glass fiber tape for joints and corners.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

### 3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- E. Install tile backer board in strict accordance with manufacturer's instructions, using corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.

### 3.03 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCA Handbook recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles bullnosed.

- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Allow tile to set for a minimum of 48 hours prior to grouting.
- K. Grout tile joints.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

#### **3.04 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
  - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
- B. Over wood substrate with backer board underlayment, install in accordance with TCA Handbook Method F144, for cementitious backer boards, with standard grout.

#### **3.05 INSTALLATION - FLOORS - MORTAR BED METHODS**

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F111, with cleavage membrane, unless otherwise indicated.
- B. Over wood substrates, install in accordance with TCA Handbook method F141, with standard grout, unless otherwise indicated.
- C. Cleavage Membrane: Lap edges and ends.
- D. Mortar Bed Thickness: 5/8 inch (15 mm), unless otherwise indicated.

#### **3.06 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. At tiled shower receptors install in accordance with TCA Handbook Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.
- C. Seal joints between tile work and other work with sealant Type specified in Section 07900.

#### **3.07 INSTALLATION - WALL TILE**

- A. Over cementitious backer units on studs, install in accordance with TCA Handbook Method W244, using membrane at toilet rooms.
- B. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise indicated.

#### **3.08 CLEANING**

- A. Clean tile and grout surfaces.

#### **3.09 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**



## SECTION 09511

### SUSPENDED ACOUSTICAL CEILINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Supplementary acoustical insulation above ceiling.

##### 1.02 RELATED REQUIREMENTS

- A. Section 07212 - Board and Batt Insulation: Acoustical insulation.
- B. Section 08310 - Access Doors and Panels: Access panels.
- C. Section 13851 - Fire Alarm System: Fire alarm components in ceiling system.
- D. Section 13925 - Fire Suppression Sprinklers: Sprinkler heads in ceiling system.
- E. Section 15850 - Air Outlets and Inlets: Air diffusion devices in ceiling.
- F. Section 16510 - Interior Luminaires: Light fixtures in ceiling system.

##### 1.03 REFERENCE STANDARDS

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2004.
- B. ASTM C 636/C 636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2006.
- C. ASTM E 580/E 580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2008a.
- D. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products; 2008.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

##### 1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 6x12 inch (152.4x304.8 mm) in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 12 inches (304.8 mm) long, of suspension system main runner, cross runner, and perimeter molding.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

## **1.06 QUALITY ASSURANCE**

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

## **1.07 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

## **PART 2 PRODUCTS**

### **2.01 ACOUSTICAL UNITS**

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc; Product Cortega Second Look 15/16" Angled Tegular: [www.armstrong.com](http://www.armstrong.com).
  - 2. Substitutions: See Section 01600 - Product Requirements.
- B. Acoustical Units - General: ASTM E 1264, Class A.
- C. Acoustical Panels Type C-1: Painted mineral fiber, ASTM E 1264 Type III, with the following characteristics:
  - 1. Size: 24 x 48 inches (600 x 1200 mm).
  - 2. Thickness: 3/4 inches (19 mm).
  - 3. Composition: Wet felted.
  - 4. Edge: Angled Tegular.
  - 5. Surface Color: White.
  - 6. Surface Pattern: Medium texture.
  - 7. Product: Cortega Second Look 2767 by Armstrong.

### **2.02 SUSPENSION SYSTEM(S)**

- A. Manufacturers:
  - 1. Same as for acoustical units.
  - 2. Substitutions: See Section 01600 - Product Requirements.
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System Type S-1: Formed steel, commercial quality cold rolled; intermediate-duty.
  - 1. Profile: Tee; 15/16 inch (24 mm) wide face.
  - 2. Finish: White painted.
  - 3. Product: Prelude 15/16" by Armstrong.

### **2.03 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
  - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Acoustical Insulation: Specified in Section 07212.
  - 1. Thickness: 2 inch (50 mm).
  - 2. Size: To fit acoustical suspension system.

## SECTION 09650

### RESILIENT FLOORING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03300 (03 3000) - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- B. Section 03505 (03 5400) - Self-Leveling Underlayment.

##### 1.03 REFERENCE STANDARDS

- A. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2008.
- B. ASTM F 1066 - Standard Specification for Vinyl Composition Floor Tile; 2004.
- C. ASTM F 1700 - Standard Specification for Solid Vinyl Floor Tile; 2004.
- D. ASTM F 1861 - Standard Specification for Resilient Wall Base; 2008.
- E. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Concrete Testing Standard: Submit a copy of ASTM F 710.

#### PART 2 PRODUCTS

##### 2.01 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness, and:
  - 1. Minimum Requirements: Comply with ASTM F 1066, of Class corresponding to type specified.
  - 2. Size: 12 x 12 inch (305 x 305 mm).
  - 3. Thickness: 0.125 inch (3.2 mm).
  - 4. Pattern: Marbleized.
  - 5. Manufacturers:
    - a. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
    - b. Mannington Mills, Inc: [www.mannington.com](http://www.mannington.com).
    - c. Tarkett Inc: [www.tarkett.com](http://www.tarkett.com).
    - d. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Vinyl Tile: Printed film type, with transparent or translucent wear layer, and:
  - 1. Minimum Requirements: Comply with ASTM F 1700, of Class corresponding to type specified.
  - 2. Size: 4"x36" inch (101.6x914.4 mm).
  - 3. Wear Layer Thickness: 0.020 inch (0.50 mm).
  - 4. Total Thickness: 0.125 inch (3 mm).

5. Pattern: To be selected by owner.
6. Manufacturers:
  - a. Amtico Company; Product W749 Wenge Wood Plank Flooring: [www.amtico.com](http://www.amtico.com).
  - b. Armstrong
  - c. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.02 RESILIENT BASE**

- A. Resilient Base: ASTM F 1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
  1. Height: 4 inch (100 mm).
  2. Thickness: 0.125 inch (3.2 mm) thick.
  3. Finish: Satin.
  4. Length: Roll.
  5. Color: Color as selected from manufacturer's standards.
  6. Manufacturers:
    - a. Burke Flooring: [www.burkemerger.com](http://www.burkemerger.com).
    - b. Johnsonite, Inc: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - d. Substitutions: See Section 01600 (01 6000) - Product Requirements.

## **2.03 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### **3.02 PREPARATION**

- A. Prepare sub-floor surfaces as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is cured.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.

- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### **3.04 TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.

#### **3.05 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

#### **3.06 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

#### **3.07 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**



## SECTION 09685

### CARPET TILE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

##### 1.02 REFERENCE STANDARDS

- A. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2008.
- B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.
- C. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.
- D. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

##### 1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 - Product Requirements, for additional provisions.
  - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

##### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum 3 years experience.

##### 1.05 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Other Acceptable Manufacturers:
  - 1. Interface, Inc; Product Common Threads Style 16754, Color: 5936 Blended:  
[www.interfaceinc.com](http://www.interfaceinc.com).

2. Substitutions: See Section 01600 - Product Requirements.

## **2.02 MATERIALS**

- A. Carpet Tile Type C-1: Tufted, manufactured in one color dye lot.
  1. Product: 1675402500 manufactured by Interface.
  2. Tile Size: 19.69x19.69 inch (500x500 mm), nominal.
  3. Thickness: .280 inch (7.1 mm).
  4. Color: 5936 Blended.
  5. Pattern: 16754.
  6. Primary Backing Material: GlasBac Tile.

## **2.03 ACCESSORIES**

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- B. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.
- C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- D. Blend carpet from different cartons to ensure minimal variation in color match.
- E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set aligned as indicated on shop drawings.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.

- I. Complete installation of edge strips, concealing exposed edges.

### **3.04 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION**



## SECTION 09850

### ACOUSTICAL PANELS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wood fiber core panels and mounting accessories.

##### 1.02 RELATED REQUIREMENTS

##### 1.03 REFERENCE STANDARDS

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
- D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available .
- E. Verification Samples: Fabricated samples of each type of panel specified; 12 x 12 in (305 x 305 mm), showing construction, edge details.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical panels from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until panels are needed for installation.
- B. Store panels flat, in dry, well-ventilated space; do not stand panels on end.
- C. Protect panel edges from damage.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Acoustical Panels:
  - 1. Tectum Inc; Product Standard Tectum Panel - Acoustical Wall Panels: [www.tectum.com](http://www.tectum.com).
- B. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 ACOUSTICAL WALL AND CEILING PANELS

- A. Panels: Prefinished panels.
- B. Wood Fiber Core Panels:
  - 1. Panel Width: As required.
  - 2. Panel Height: As required.
  - 3. Panel Thickness: 1-1/2 in (38 mm).

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical panels. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

**END OF SECTION**

## SECTION 09900

### PAINTS AND COATINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Materials for backpriming woodwork.
- D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Elevator pit ladders.
  - 3. Exposed surfaces of steel lintels and ledge angles.
  - 4. Prime surfaces to receive wall coverings.
  - 5. Mechanical and Electrical:
    - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
    - d. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
    - e. Paint dampers exposed behind louvers, grilles, to match face panels.
- E. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically so indicated.
  - 8. Ceramic and other tiles.
  - 9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
  - 10. Glass.
  - 11. Concrete masonry in utility, mechanical, and electrical spaces.
  - 12. Acoustical materials, unless specifically so indicated.
  - 13. Concealed pipes, ducts, and conduits.

##### 1.02 RELATED REQUIREMENTS

- A. Section 02765 (32 1723.13) - Pavement Markings: Painted pavement markings.
- B. Section 05500 (05 5000) - Metal Fabrications: Shop-primed items.
- C. Section 05510 (05 5100) - Metal Stairs: Shop-primed items.
- D. Section 15075 (22 0553) - Mechanical Identification: Painted identification.

- E. Section 16075 (26 0553) - Electrical Identification: Painted identification.

### **1.03 DEFINITIONS**

- A. Conform to ASTM D 16 for interpretation of terms used in this section.

### **1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2008.
- C. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

### **1.05 SUBMITTALS**

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8x11 inch (203.2x279.4 mm) in size.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 (01 6000) - Product Requirements, for additional provisions.
  - 2. Extra Paint and Coatings: 1 gallon (4 L) of each color; store where directed.
  - 3. Label each container with color in addition to the manufacturer's label.

### **1.06 MOCK-UP**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 8 feet (2.44 m) long by 8 feet (2.44 m) wide, illustrating special coating color, texture, and finish.
- C. Provide door and frame assembly illustrating stain and varnish coating color, texture, and finish.
- D. Locate where directed.
- E. Mock-up may remain as part of the work.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

### **1.08 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  - 1. Base Manufacturer: See Section 09910 (09 9100).
  - 2. Glidden Professional: [www.gliddenprofessional.com](http://www.gliddenprofessional.com).
  - 3. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 4. PPG Architectural Finishes, Inc: [www.ppgaf.com](http://www.ppgaf.com).
- C. Transparent Finishes:
  - 1. Base Manufacturer: See Section 09930 (09 9300).
- D. Primer Sealers:
- E. Field-Catalyzed Coatings:
- F. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.02 PAINTS AND COATINGS - GENERAL**

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 3. Supply each coating material in quantity required to complete entire project's work from a single production run.
  - 4. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:

- a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
  - b. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: As indicated on drawings
- 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint WE-OP-3A - Wood, Opaque, Alkyd, 3 Coat:
  - 1. One coat of alkyd primer sealer.
- B. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
  - 1. One coat of alkyd primer.
  - 2. Gloss: Two coats of alkyd enamel; .
- C. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
  - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  - 2. Gloss: Two coats of alkyd enamel; .
- D. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
  - 1. One coat galvanize primer.
  - 2. Gloss: Two coats of alkyd enamel; .

### 2.04 PAINT SYSTEMS - INTERIOR

- A. Paint WI-OP-2L - Wood, Opaque, Latex, 2 Coat:
  - 1. One coat of latex primer sealer.
  - 2. Eggshell: One coat of latex enamel; \_\_\_\_\_.
  - 3. Flat: One coat of latex enamel; .
- B. Paint WI-TR-VS - Wood, Transparent, Varnish, Stain:
  - 1. Filler coat (for open grained wood only).
  - 2. One coat of stain; .
  - 3. One coat sealer; .
  - 4. Satin: Two coats of varnish; .
- C. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
  - 1. Touch-up with alkyd primer.
  - 2. Gloss: Two coats of alkyd enamel; .
- D. Paint GI-OP-2LA - Gypsum Board/Plaster, Latex-Acrylic, 2 Coat:
  - 1. One coat of alkyd primer sealer.
  - 2. Semi-gloss: One coat of latex-acrylic enamel; .
  - 3. Eggshell: One coat of latex-acrylic enamel; .
  - 4. Flat: One coat of latex-acrylic enamel; .

### 2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.

- C. Fastener Head Cover Material: Latex filler.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.
  - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  - 3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
  - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- J. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- K. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- L. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

- M. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- N. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- O. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- P. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- Q. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

### **3.03 APPLICATION**

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's instructions.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01400 (01 4000) - Quality Requirements, for general requirements for field inspection.

### **3.05 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### **3.06 PROTECTION**

- A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

**END OF SECTION**



## SECTION 09930

### STAINING AND TRANSPARENT FINISHING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Transparent wood finish systems for field application.
- B. Additional product requirements, execution, and surfaces not to be finished are specified in Section 09900.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Base Manufacturer:
  - 1. Pratt & Lambert Paints: [www.prattandlambert.com](http://www.prattandlambert.com).
  - 2. Products of other manufacturers may be used under conditions specified in Section 09900.
- B. Sanding Sealers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

##### 2.02 EXTERIOR TRANSPARENT FINISH SYSTEMS

- A. Exterior Wood - Stain Finish: For all exterior wood items except traffic surfaces.
  - 1. Preparation as specified by manufacturer.
  - 2. Flat Opaque: 2 coats STAINShield Solid Color Latex Siding Stain (100 percent Acrylic).

##### 2.03 INTERIOR TRANSPARENT FINISH SYSTEMS

- A. Interior Wood - Natural Clear Finish: For all interior wood items unless otherwise indicated:
  - 1. Preparation as specified by manufacturer.
  - 2. 1 coat Sanding Sealer recommended by manufacturer.
- B. Interior Wood - Acrylic Stain with Clear Finish: For all interior wood items unless otherwise indicated:
  - 1. Preparation as specified by manufacturer.
  - 2. Stain: 1 coat Acrylic Latex Stain - Interior.
  - 3. Intermediate Coat: 2 coats Acrylic Latex Varnish Gloss.
  - 4. Sand after first coat of clear finish.

#### PART 3 EXECUTION (SEE SECTION 09900)

END OF SECTION



## SECTION 10305

### MANUFACTURED FIREPLACES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Manufactured steel box fireplace.
- B. Accessories, including circulating fan.
- C. Insulated chimney flue and associated roof flashings.

##### 1.02 RELATED REQUIREMENTS

- A. Section 15145 - Plumbing Piping: Gas piping to fire box.
- B. Section 16155 - Equipment Wiring.

##### 1.03 REFERENCE STANDARDS

- A. UL 127 - Standard for Factory-Built Fireplaces; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

##### 1.04 SYSTEM DESCRIPTION

- A. Built-in firebox with concealed flue; rectangular shape; gas starter and circulating fan.

##### 1.05 DESIGN REQUIREMENTS

- A. Fuel: Natural gas specified in Section 15145.

##### 1.06 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide fire box cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvals, electrical characteristics of fan.
- C. Shop Drawings: Indicate fire box rough opening dimensions, rough opening sizes for chimney flue, fan size.
- D. Manufacturer's Certificate: Certify that fireplace components meet or exceed UL requirements.
- E. Manufacturer's Instructions: Indicate installation procedures and component installation sequence, clearances and tolerances from adjacent construction.

##### 1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.
- B. Listed by Underwriters Laboratories Inc. as complying with UL 127.
- C. Products Requiring Electrical Connection: Listed and labeled by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Manufactured Fireplaces:
  - 1. Eviro; Product DV 50 DX The Cottage .
  - 2. Substitutions: See Section 01600 - Product Requirements.

## **2.02 COMPONENTS**

- A. Fire Box: Formed insulated steel cabinet, rectangular shaped interior, configured to include chimney outlet and cleanout, 5-sided eramic firebox liner.
  - 1. Hearth Opening: 39 5/8 inches (1006.5 mm) wide x 33 1/4 inches (844.55 mm) high x 20 3/8 inches (517.5 mm) deep.
  - 2. Combustion Air Source: Ducted outside air with screened grilles and ducts.
  - 3. BTU rating: 50,000.
- B. Exposed Cladding: Prepainted steel.
- C. Fire Box Closure: Clear tempered in black steel frame.
- D. Flue Construction: Insulated stainless steel sandwich construction, modular sized sections with elbows and spacing collars to permit site assembly, air and fire stop collars, elbows, elbow offsets, tees, supports, roofing storm collar, roof flashing; nominal inside diameter of 8 inches (200 mm).

## **2.03 ACCESSORIES**

- A. Circulating Fans: Motor and fan, UL approved, 120 volt, with remote variable speed control switch, sheet steel enclosure, and face grille.

## **2.04 FACTORY FINISHING**

- A. Exposed to View Surfaces: Metallic Black Paint; Cottage Trim Option color as selected.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that prepared openings are ready to receive work and opening dimensions are as instructed by the manufacturer.
- B. Verify that proper power supply and fuel source are available.

### **3.02 INSTALLATION**

- A. Install unit assembly in accordance with manufacturer's instructions and UL requirements.
- B. Install chimney plumb through prepared openings using fire stop spacers.
- C. Secure chimney in opening framing with appropriate fasteners.
- D. Carefully cut holes for fan wall switch and grilles.
- E. Install roof flashings to ensure moisture is shed from chimney flue.

### **3.03 TOLERANCES**

- A. Maximum Variation of Chimney From Plumb: 1/2 inch (12 mm).

**END OF SECTION**

## SECTION 10400

### IDENTIFICATION DEVICES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Interior directional and informational signs.
- D. Emergency evacuation maps.
- E. Building identification signs.
- F. Plaque.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06110 - Rough Carpentry.

##### 1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01210 (01 2100) - Allowances, for cash allowances affecting this section.
- B. Room and door signs are not covered by the allowance.
- C. Allowance amount covers purchase, delivery, and installation.

##### 1.04 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

##### 1.05 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.

- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

## **1.07 FIELD CONDITIONS**

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
  - 2. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).
  - 3. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
  - 4. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Dimensional Letter Signs:
  - 1. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- C. Other Signs:
  - 1. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- D. Plaques:
  - 1. Substitutions: See Section 01600 (01 6000) - Product Requirements.

### **2.02 SIGNAGE APPLICATIONS**

- A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  - 1. Sign Type: Flat signs with engraved panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
  - 3. Character Height: 1 inch (25 mm).
  - 4. Sign Height: 3 inches (75 mm), unless otherwise indicated.
  - 5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
  - 6. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
  - 7. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
  - 1. Sign Type: Same as room and door signs.

2. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- D. Emergency Evacuation Maps:
1. Allow for one map per elevator lobby.
  2. Map content to be provided by Owner.
  3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- E. Building Identification Signs:
- F. Plaque: See Allowance for details.

### **2.03 SIGN TYPES**

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
  2. Corners: Square.
  3. Wall Mounting of One-Sided Signs: Tape adhesive.
  4. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
  5. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: As Selected.
  4. Character Color: Contrasting color.

### **2.04 TACTILE SIGNAGE MEDIA**

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/8 inch (3 mm).

### **2.05 NON-TACTILE SIGNAGE MEDIA**

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
1. Sign Color: Color as selected.
  2. Total Thickness: 1/8 inch (3 mm).

### **2.06 ACCESSORIES**

- A. Tape Adhesive: Double sided tape, permanent adhesive.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:

1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches (1525 mm) above finished floor.
  2. If no location is indicated obtain Owner's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

**END OF SECTION**

## SECTION 10523

### FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06100 (06 1000) - Rough Carpentry: Wood blocking product and execution requirements.

##### 1.03 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2010.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, and location.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

##### 1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fire Extinguishers:
  - 1. JL Industries, Inc.; Product Cosmic 5E.
  - 2. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. JL Industries, Inc; Product 1017P42 W: [www.jlindustries.com](http://www.jlindustries.com).
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Cast steel tank, with pressure gage.
  - 1. Finish: Baked enamel, Red color.

##### 2.03 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.

- B. Cabinet Configuration: Semi-recessed type.
  - 1. Exterior nominal dimensions of 13 7/8 inch (352.4 mm) wide x 27 3/8 inch (695.3 mm) high x 3 inch (76.2 mm) deep.
  - 2. Trim: Returned to wall surface, with 3 inch (76.2 mm) projection, 13 7/8 inch (352.4 mm) wide face.
- C. Door Glazing: Plastic, clear, 1/8 inch (3 mm) thick acrylic. Set in resilient channel gasket glazing.
- D. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- E. Weld, fill, and grind components smooth.
- F. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.
- G. Finish of Cabinet Interior: White enamel.

#### **2.04 ACCESSORIES**

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets.

**END OF SECTION**

## SECTION 10552

### MAIL BOXES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Multiple mail boxes with hinged and locked doors.

##### 1.02 REFERENCE STANDARDS

- A. 39 CFR 111 - U.S. Postal Service Standard 4C; effective date September 3, 2006.

##### 1.03 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for components.
- C. Shop Drawings: Indicate locations, construction and anchorage details, dimensions, rough-in openings sizes, quantity and arrangement of box sizes.
  - 1. Show field measurements on shop drawings.
- D. Samples: Submit two samples, 6X6 inch (152.4X152.4 mm) in size illustrating surface finishes.
- E. Manufacturer's Instructions: Include installation procedures, special considerations, and maintenance information.

##### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Mail Boxes:
  - 1. Auth-Florence Manufacturing Company: [www.authflorence.com](http://www.authflorence.com).
  - 2. Salsbury Industries; Product 3711D-20FL USPS Access: [www.mailboxes.com](http://www.mailboxes.com).
  - 3. Substitutions: See Section 01600 (01 6000) - Product Requirements.

##### 2.02 MAIL BOXES SERVED BY U.S. POSTAL SERVICE

- A. Comply with U.S. Postal Service Standard 4C.

##### 2.03 COMPONENTS

- A. Front Loading Panel Frame:
  - 1. Edges beveled, piano hinged jamb, prepared for Post Office lock cylinder.
- B. Box Door:
  - 1. Bronze with satin finish.
  - 2. Edges beveled, piano hinged jamb, prepared for lock cylinder.
- C. Box Construction: Sheet steel, zinc coated, 22 gage (0.8 mm) thick, fabricated into modular stackable units, baked enamel flat black finish. Pre-punch bolt holes in box for stack bolting to each other and anchoring to adjacent construction; label plates for identifying each box.
- D. Postal Box Locks: USPS standard, two keys per box.

- E. "Out-Going Mail" Lock Box: Face plate to match front loading panel frame, box of galvanized steel construction, 13 1/4"x6 1/2"x17" inch (337x165x432 mm) size, lockable with cylinder provided by Post Office.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as instructed by the manufacturer.
- B. Verify that prepared openings are ready to receive work.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and U.S. Postal Service regulations.
- B. Install and secure boxes in position, neatly, and accurately stacked.
- C. Install doors and adjust to operate smoothly.

#### **3.03 SCHEDULES**

- A. Mail Drop 2255 with custom Engraving #2266 and receptacle #2256. Text on Mail Slot to Read: MANAGER. Bronze finish: [www.mailboxes.com](http://www.mailboxes.com).
- B. 3711D-20FL USPS Access Mail boxes with "Out-Going Mail". Color: Bronze. Quantity 4, ganged together as shown on drawings.

**END OF SECTION**

## SECTION 10673

### WALL MOUNTED STANDARDS AND SHELVING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Shelf standards, brackets, and accessories.
- B. Shelves.
- C. See drawings for locations and configurations.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06100 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 09260 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

##### 1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

##### 1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01600 - Product Requirements, for additional provisions.
  - 2. Extra Brackets: Ten of each size of standard straight bracket.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Shelf Standards and Brackets:
  - 1. Knap & Vogt Manufacturing Company: [www.knapeandvogt.com](http://www.knapeandvogt.com).
  - 2. Substitutions: See Section 01600 - Product Requirements.
- B. Shelves:
  - 1. Substitutions: See Section 01600 - Product Requirements.

##### 2.02 MATERIALS

- A. Decorative Heavy Duty Shelf Standards: Double-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.

1. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds (135 to 200 kg) per pair of standards.
  2. Lengths: As indicated on drawings.
  3. Finish: Powder-coated, color to be selected from manufacturer's full line.
  4. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
  5. Bracket Quantity: Provide one bracket for each 12 inches (305 mm) of standard length.
- B. Shelf Standard Accessories:
1. Where shelves are indicated to be fastened to brackets provide brackets with flanges for screwing into end of shelf, steel shelf rests, or flanged brackets; fasten with screws.
  2. Provide other accessories as indicated.
- C. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
1. Edge Finish: Matching laminate, all four edges.
  2. Substrate Thickness: 3/4 inch (19 mm), nominal.
  3. Laminate: NEMA LD 3 Type HGL.
  4. Laminate Color and Pattern: To be selected later.
- D. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.

### **3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

## SECTION 10800

### TOILET, BATH, AND LAUNDRY ACCESSORIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Accessories for toilet rooms, showers, residential bathrooms, and utility rooms.
- B. Grab bars.

##### 1.02 RELATED REQUIREMENTS

- A. Section 06110 - Rough Carpentry: Placement of concealed anchor devices.
- B. Section 08830 - Mirrors: Other mirrors.
- C. Section 09300 - Tile: Ceramic washroom accessories.

##### 1.03 REFERENCE STANDARDS

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- B. ASTM A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip; 1999 (Reapproved 2004).
- C. ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2008.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

##### 1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products listed are made by American Specialties, Inc. ASI.
- B. Other Acceptable Manufacturers:
  - 1. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
  - 2. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 3. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com).
  - 4. Substitutions: Section 01600 - Product Requirements.
- C. All items of each type to be made by the same manufacturer.

##### 2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

## 2.03 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, chrome-plated zinc alloy brackets, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
  - 1. Waste receptacle liner: Reusable, heavy-duty vinyl.
  - 2. Towel dispenser capacity: 400 C-fold.
  - 3. Waste receptacle capacity: 4 gallons (15 liters).
  - 4. Product: Model 2027 manufactured by Bradley.
- C. Grab Bars: Stainless steel, 1-1/4 inches (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches (38 mm) clearance between wall and inside of grab bar.
  - 1. Length and configuration: As indicated on drawings.

## 2.04 SHOWER AND TUB ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for concealed mounting.
- B. Shower Curtain:
  - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  - 2. Material: Cotton, machine washable, and mildew-resistant.
  - 3. Size: 72 by 72 inches (1830 by 1830 mm), hemmed edges.
  - 4. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
  - 5. Color: White.
- C. Folding Shower Seat: Wall-mounted recessed; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right-hand seat.
  - 1. Seat: Teakwood slats secured to supporting frame members with stainless steel screws. Ease edges of each slat.
  - 2. Size: ADA compliant.
- D. Towel Pin: Stainless steel, 3 inch (75 mm) extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.

## 2.05 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, hat-shaped channel.
  - 1. Product: 8215-3 manufactured by ASI.
- B. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
  - 1. Product: 1308-3 manufactured by ASI.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. See Section \_\_\_\_\_ for installation of blocking, reinforcing plates, and concealed anchors in walls, and ceilings.

### **3.02 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### **3.03 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations

**END OF SECTION**



## SECTION 14201

### PASSENGER ELEVATORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Complete elevator systems.
- B. Elevator maintenance.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01500 (01 5000) - Temporary Facilities and Controls: Temporary power supply.
- B. Section 03300 (03 3000) - Cast-in-Place Concrete: Elevator machine foundation.
- C. Section 04810 (04 2000) - Unit Masonry Assemblies: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
- D. Section 05120 (05 1200) - Structural Steel: Hoistway framing.
- E. Section 05500 (05 5000) - Metal Fabrications: Pit ladder, Sill supports, and overhead hoist beams.
- F. Section 10523 (10 4400) - Fire Extinguishers, Cabinets and Accessories: Fire extinguisher in elevator machine room.
- G. Section 13925 (21 1300) - Fire Suppression Sprinklers: Sprinkler heads in hoistway.
- H. Section 15430 (22 3000) - Plumbing Equipment: Pit sump and pump.
- I. Section 13851 (28 3100) - Fire Alarm System:

##### 1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National fire Protection Association; 2008.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting one week prior to starting work.
  - 1. Review schedule of installation, installation procedures and conditions, and coordination with related work.

##### 1.05 SUBMITTALS

- A. See Section 01300 (01 3000) - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate the following information:
  - 1. Locations of machine room equipment: driving machines, controllers, governors and other component.
  - 2. Hoistway components: Car, counterweight, sheaves, machine and sheave beams, guide rails, buffers, ropes, and other components.
  - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
  - 4. Individual weight of principal components; load reaction at points of support.
  - 5. Loads on hoisting beams and location of trolley beams.
  - 6. Clearances and over-travel of car and counterweight.
  - 7. Location and sizes of access doors, doors, and frames.
  - 8. Expected heat dissipation of elevator equipment in machine room.
  - 9. Electrical characteristics and connection requirements.

10. Show arrangement of equipment in machine room so rotating elements, sheaves, and other equipment can be removed for repairs or replaced without disturbing other components. Arrange equipment for clear passage through access door.
- C. Product Data: Provide data on the following items:
1. Signal and operating fixtures, operating panels, indicators.
  2. Cab design, dimensions, layout, and components.
  3. Cab and hoistway door and frame details.
- D. Maintenance Data: Include:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
  2. Technical information for servicing operating equipment.
  3. Legible schematic of hydraulic piping and wiring diagrams of installed electrical equipment and changes made in the Work. List symbols corresponding to identity or markings on machine room and hoistway apparatus.

### **1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with applicable code and as supplemented in this section.
- B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a Professional Structural Engineer experienced in design of work of this type and licensed in the state in which the Project is located.
- C. Perform electrical work in accordance with NFPA 70.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.

### **1.07 WARRANTY**

- A. See Section 01780 (01 7800) - Closeout Submittals, for additional warranty requirements.
- B. Provide one year manufacturer warranty for elevator operating equipment and devices.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Schindler Elevator Corp. [www.us.schindler.com](http://www.us.schindler.com); Product 330A Hydraulic Elevator.
- B. Other Acceptable Manufacturers:
1. ThyssenKrupp Elevator: [www.thyssenkruppelevator.com](http://www.thyssenkruppelevator.com).
  2. Otis Elevator Co: [www.otis.com](http://www.otis.com).
  3. Substitutions: See Section 01600 (01 6000) - Product Requirements.
- C. All components to be manufactured by same entity, unless otherwise indicated.

### **2.02 ELEVATORS**

- A. Elevator No.1: Passenger, holeless hydraulic type with cylinder in hoistway.
1. Schindler Elevator Corp. System 330A Hydraulic Elevator.
  2. Operation and Controls: Microprocessor Single Car Automatic Operation with Onboard Diagnostic Capabilities.
  3. Hoistway Doors and Frames: Baked enamel on steel.
  4. Cab Height: 96 inches (\_\_\_\_ mm).
  5. Travel Distance: As indicated on drawings.

6. Number of Stops: 2.
7. Number of Openings: 2 Front.
8. Hydraulic Motor and Pump Location: Adjacent to hoistway.

### **2.03 CONTROLS**

- A. Elevator Controls: Provide landing buttons and hall lanterns.
- B. Door Controls:
  1. Program door control to open doors automatically when car arrives at floor.
  2. Render "Door Close" button inoperative when car is standing at dispatching terminal with doors open.
  3. If doors are prevented from closing for approximately ten seconds because of an obstruction, automatically disconnect door reopening devices, close doors more slowly until obstruction is cleared. Sound buzzer.
  4. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equip with photo-electric light rays.
- C. Landing Buttons: Stainless steel type, one for originating UP and one for originating DOWN calls, one button only at terminating landings; marked with arrows.
- D. Provide "Firefighter's Operation" in accordance with applicable code. Designated Landing:  
\_\_\_\_\_

### **2.04 MACHINE ROOM FITTINGS**

- A. Wall-Mounted Frames: Glazed with clear plastic; sized as required. Provide one for master electric and hydraulic schematic and one for lubrication chart. Install charts.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of the correct characteristics.

### **3.02 PREPARATION**

- A. Arrange for temporary electrical power for installation work and testing of elevator components.

### **3.03 INSTALLATION**

- A. Install system components, including emergent telephone and connection to car. Connect equipment to building utilities.
- B. Provide conduit, boxes, wiring, and accessories.
- C. Mount machines on vibration and acoustic isolators, on bed plate and concrete pad. Place on structural supports and bearing plates. Securely fasten to building supports. Prevent lateral displacement.
- D. Accommodate equipment in space indicated.
- E. Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.
- F. Accurately machine and align guide rails. Form smooth joints with machined splice plates.

- G. Coordinate installation of hoistway wall construction.
- H. Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.
- I. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- J. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- K. Adjust equipment for smooth and quiet operation.

#### **3.04 ERECTION TOLERANCES**

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1.

#### **3.05 FIELD QUALITY CONTROL**

- A. Testing and inspection by regulatory agencies will be performed at their discretion.
  1. Schedule tests with agencies and notify Owner and Architect.
  2. Obtain permits required to perform tests.
  3. Document regulatory agency tests and inspections in accordance with the requirements of Section 01400 (01 4000).
  4. Perform tests required by regulatory agencies.
  5. Furnish test and approval certificates issued by authorities having jurisdiction.

#### **3.06 ADJUSTING**

- A. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- B. Adjust automatic floor leveling feature at each floor to achieve 1/4 inch (6 mm) from flush.

#### **3.07 CLEANING**

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components ready for inspection.

#### **3.08 PROTECTION**

- A. Do not permit construction traffic within cab after cleaning.
- B. Protect installed products until project completion.
- C. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

#### **3.09 MAINTENANCE**

- A. See Section 01700 (01 7000) - Execution Requirements, for additional requirements relating to maintenance service.
- B. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the elevator manufacturer or original installer.
- C. Provide service and maintenance of elevator system and components for one year from Date of Substantial Completion.
- D. Examine system components monthly. Clean, adjust, and lubricate equipment.
- E. Include systematic examination, adjustment, and lubrication of elevator equipment. Maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment. Replace wire ropes when necessary to maintain the required factor of safety.

F. Perform work without removing cars during peak traffic periods.

**END OF SECTION**



## SECTION 220500

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following:
  1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical sleeve seals.
  5. Sleeves.
  6. Escutcheons.
  7. Grout.
  8. Equipment installation requirements common to equipment sections.
  9. Concrete bases.
  10. Supports and anchorages.

##### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  1. PE: Polyethylene plastic.
- G. The following are industry abbreviations for rubber materials:
  1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

##### 1.04 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

**1.05 QUALITY ASSURANCE**

- A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes 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.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

**1.07 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

**PART 2 - PRODUCTS**

**2.01 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

**2.02 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

**2.03 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

- 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

#### **2.04 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F .
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F .
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F .

#### **2.05 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### **2.06 SLEEVES**

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

#### **2.07 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

- 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed] hinge and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## **2.08 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi , 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
  - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Aboveground, Exterior-Wall Pipe 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.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.02 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

### **3.03 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.06 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 220500**

## SECTION 220513

### COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

##### 2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 5300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

##### 2.03 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

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

**END OF SECTION 220513**

## SECTION 220523

### GENERAL-DUTY VALVES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following general-duty valves:
  - 1. Copper-alloy ball valves.
  - 2. Bronze check valves.
- B. Related Sections include the following:
  - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
  - 2. Division 22 piping Sections for specialty valves applicable to those Sections only.

##### 1.03 DEFINITIONS

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. PTFE: Polytetrafluoroethylene plastic.
  - 3. TFE: Tetrafluoroethylene plastic.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

##### 1.05 QUALITY ASSURANCE

- A. NSF Compliance: NSF 61 for valve materials for potable-water service.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

#### PART 2 - PRODUCTS

## **2.01 VALVES, GENERAL**

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- E. Extended Valve Stems: On insulated valves.
- F. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- G. Valve Grooved Ends: AWWA C606.
  - 1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
- H. Valve Bypass and Drain Connections: MSS SP-45.

## **2.02 COPPER-ALLOY BALL VALVES**

- A. Copper-Alloy Ball Valves, General: MSS SP-110.
- B. Three-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 250 psig minimum CWP rating and blowout-proof stem.

## **2.03 BRONZE CHECK VALVES**

- A. Bronze Check Valves, General: MSS SP-80.
- B. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### **3.02 VALVE APPLICATIONS**

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly valves.
  - 2. Throttling Service: Angle, ball, butterfly, or globe valves.
  - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
  - 1. Ball Valves, NPS 2 and Smaller: Three-piece, 400-psig CWP rating, copper alloy.
  - 2. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
- D. Select valves, except wafer and flangeless types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.

### **3.03 VALVE INSTALLATION**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

### **3.04 JOINT CONSTRUCTION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### **3.05 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

**END OF SECTION 220523**



## SECTION 220529

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

###### A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

###### B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

##### 1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### **1.05 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  1. Trapeze pipe hangers.
  2. Metal framing systems.
  3. Fiberglass strut systems.
  4. Pipe stands.
  5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  1. Detail fabrication and assembly of trapeze hangers.
  2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

#### **1.06 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

### **PART 2 - PRODUCTS**

#### **2.01 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## **2.02 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## **2.03 FIBERGLASS PIPE HANGERS**

- A. Clevis-Type, Fiberglass Pipe Hangers:
  1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
  2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass polyurethane.
- B. Strap-Type, Fiberglass Pipe Hangers:
  1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
  2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

## **2.04 METAL FRAMING SYSTEMS**

- A. MFMA Manufacturer Metal Framing Systems:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  3. Standard: MFMA-4.
  4. Channels: Continuous slotted steel channel with inturned lips.
  5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  7. Metallic Coating: Electroplated, zinc Hot-dipped galvanized, Mill galvanized In-line, hot galvanized, Mechanically-deposited zinc.
  8. Paint Coating: Vinyl, Vinyl alkyd, Epoxy Polyester, Acrylic, Amine ,Alkyd.
  9. Plastic Coating: PVC, Polyurethane, Epoxy Polyester.
- B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products Inc.
  - b. Empire Industries, Inc.
  - c. ERICO International Corporation.
  - d. Haydon Corporation; H-Strut Division.
  - e. NIBCO INC.
  - f. PHD Manufacturing, Inc.
  - g. PHS Industries, Inc.
3. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
4. Standard: Comply with MFMA-4.
5. Channels: Continuous slotted steel channel with inturned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

#### **2.05 THERMAL-HANGER SHIELD INSERTS**

- A. Manufacturers: Subject to compliance with requirements:
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

#### **2.06 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### **2.07 PIPE STANDS**

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

## **2.08 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## **2.09 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.010 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi , 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.01 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- H. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
5. Pipes and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.02 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.03 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### **3.04 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.05 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 a minimum dry film thickness of 2.0 mils .
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### **3.06 HANGER AND SUPPORT SCHEDULE**

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 .
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F , pipes NPS 4 to NPS 24 , requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 , requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 , to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 .
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 .
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 .
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 .
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 .
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 .
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 .
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 , from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 , from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb .
    - b. Medium (MSS Type 32): 1500 lb .
    - c. Heavy (MSS Type 33): 3000 lb .
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches .
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION 220529**



## SECTION 220553

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Pipe labels.

##### 1.03 SUBMITTALS

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

##### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### PART 2 - PRODUCTS

##### 2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: Yellow.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F .
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches , 1/2 inch for viewing distances up to 72 inches , and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where

equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## **2.02 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches .

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.02 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.03 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
  - 1. Domestic Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Black.
  - 2. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Yellow.

b. Letter Color: Black.

**END OF SECTION 220553**



## SECTION 220700

### PLUMBING INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:

- a. Cellular glass.
- b. Flexible elastomeric.
- c. Phenolic.
- d. Polyisocyanurate.
- e. Polyolefin.
- f. Polystyrene.

- 2. Insulating cements.

- 3. Adhesives.

- 4. Mastics.

- 5. Tapes.

- B. Related Sections include the following:

- 1. Division 21 Section " Fire-Suppression Systems Insulation."
- 2. Division 23 Section "HVAC Insulation."

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

- 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### **1.06 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### **1.07 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Block Insulation: ASTM C 552, Type I.
  - 2. Special-Shaped Insulation: ASTM C 552, Type III.
  - 3. Board Insulation: ASTM C 552, Type IV.
  - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

## **2.02 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F .
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

## **2.03 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F .
  - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 4. Color: White.

## **2.04 TAPES**

- A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches .
  - 2. Thickness: 3.7 mils .
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F . Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

- 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

### **3.04 GENERAL PIPE INSULATION INSTALLATION**

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.05 CELLULAR-GLASS INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.06 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.07 FINISHES**

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.08 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.09 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.010 INDOOR PIPING INSULATION SCHEDULE**

- A. Domestic Cold Water: not required for fixture branch run-outs.
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 3/4" thick.
    - b. Flexible Elastomeric: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
    - a. Cellular Glass: 1" thick.
    - b. Flexible Elastomeric: 3/4" thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 3/4 inch thick.

2. NPS 1-1/2 Insert pipe size and Larger: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following (FOR HORIZONTAL PIPING ONLY):

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.

**END OF SECTION 220700**



## SECTION 221116

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
  - 2. Encasement for piping.
  - 3. Specialty valves.
  - 4. Flexible connectors.
  - 5. Water meters.
  - 6. Escutcheons.
  - 7. Sleeves and sleeve seals.
  - 8. Wall penetration systems.

##### 1.03 SUBMITTALS

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Flexible connectors.
  - 5. Water meters.
  - 6. Backflow preventers and vacuum breakers.
  - 7. Escutcheons.
  - 8. Sleeves and sleeve seals.
  - 9. Water penetration systems.

##### 1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

##### 1.05 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### PART 2 - PRODUCTS

## 2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
  - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
  - 5. Copper Pressure-Seal-Joint Fittings:
    - a. 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:
      - 1) Elkhart Products Corporation; Industrial Division.
      - 2) NIBCO INC.
      - 3) Viega; Plumbing and Heating Systems.
    - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - 6. Copper-Tube Extruded-Tee Connections:
    - a. 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:
      - 1) T-DRILL Industries Inc.
    - b. Description: Tee formed in copper tube according to ASTM F 2014.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
  - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 2. Copper Pressure-Seal-Joint Fittings:
    - a. 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:
      - 1) Elkhart Products Corporation; Industrial Division.
      - 2) NIBCO INC.
      - 3) Viega; Plumbing and Heating Systems.
    - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

### **2.03 DUCTILE-IRON PIPE AND FITTINGS**

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
  - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. 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. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
    - a. Gaskets: AWWA C111, rubber.
  - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
    - a. Gaskets: AWWA C111, rubber.
- C. Plain-End, Ductile-Iron Pipe: AWWA C151.
  - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
    - a. 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:
      - 1) Anvil International.
      - 2) Shurjoint Piping Products.
      - 3) Star Pipe Products.
      - 4) Victaulic Company.
    - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
    - c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

### **2.04 CPVC PIPING**

- A. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- B. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

### **2.05 PEX TUBE AND FITTINGS**

- A. PEX Distribution System: UPONOR AQUAPEX tubing and PROPEX fittings

### **2.06 PVC PIPE AND FITTINGS**

- A. PVC Pipe: ASTM D 1785, Schedule 40.
  - 1. PVC Socket Fittings: ASTM D 2466 for Schedule 40.
  - 2. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

### **2.07 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

**2.08 ENCASEMENT FOR PIPING**

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness.
- D. Color: Natural.

**2.09 SPECIALTY VALVES**

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. CPVC Union Ball Valves:
  - 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. American Valve, Inc.
    - b. Asahi/America, Inc.
    - c. Colonial Engineering, Inc.
    - d. Fischer, George Inc.
    - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
    - f. IPEX Inc.
    - g. NIBCO INC.
    - h. Sloane, George Fischer, Inc.
    - i. Spears Manufacturing Company.
    - j. Thermoplastic Valves Inc.
  - 2. Description:
    - a. Standard: MSS SP-122.
    - b. Pressure Rating: 125 psig at 73 deg F.

- c. Body Material: CPVC.
  - d. Body Design: Union type.
  - e. End Connections for Valves NPS 2 and Smaller: Detachable, threaded.
  - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket.
  - g. Ball: CPVC; full port.
  - h. Seals: PTFE or EPDM-rubber O-rings.
  - i. Handle: Tee shaped.
- D. CPVC Ball Check Valves:
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. American Valve, Inc.
    - b. Asahi/America, Inc.
    - c. Colonial Engineering, Inc.
    - d. Fischer, George Inc.
    - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
    - f. IPEX Inc.
    - g. NIBCO INC.
    - h. Sloane, George Fischer, Inc.
    - i. Spears Manufacturing Company.
    - j. Thermoplastic Valves Inc.
  2. Description:
    - a. Pressure Rating: 125 psig at 73 deg F.
    - b. Body Material: CPVC.
    - c. Body Design: Union-type ball check.
    - d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
    - e. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket.
    - f. Ball: CPVC.
    - g. Seals: EPDM- or FKM-rubber O-rings.

## **2.010 TRANSITION FITTINGS**

- A. General Requirements:
  1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Dresser Piping Specialties.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc; a Sensus company.
    - g. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Fittings:
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. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Spears Manufacturing Company.
  2. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.
- E. Plastic-to-Metal Transition Unions:
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. Colonial Engineering, Inc.
    - b. NIBCO INC.
    - c. Spears Manufacturing Company.
  2. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

#### **2.011 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
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. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Hart Industries International, Inc.
    - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:
    - a. Pressure Rating: 150 psig at 180 deg F.
    - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
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. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Factory-fabricated, bolted, companion-flange assembly.
    - b. Pressure Rating: 150 psig.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Couplings:
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. Calpico, Inc.
    - b. Lochinvar Corporation.
  2. Description:
    - a. Galvanized-steel coupling.
    - b. Pressure Rating: 300 psig at 225 deg F.
    - c. End Connections: Female threaded.
    - d. Lining: Inert and noncorrosive, thermoplastic.
- E. Dielectric Nipples:
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. Perfection Corporation; a subsidiary of American Meter Company.
    - b. Precision Plumbing Products, Inc.
    - c. Victaulic Company.
  2. Description:
    - a. Electroplated steel nipple complying with ASTM F 1545.
    - b. Pressure Rating: 300 psig at 225 deg F.
    - c. End Connections: Male threaded or grooved.
    - d. Lining: Inert and noncorrosive, propylene.

## 2.012 FLEXIBLE CONNECTORS

- A. 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:
  - 1. Flex-Hose Co., Inc.
  - 2. Flexicraft Industries.
  - 3. Flex Pression, Ltd.
  - 4. Flex-Weld, Inc.
  - 5. Hyspan Precision Products, Inc.
  - 6. Mercer Rubber Co.
  - 7. Metraflex, Inc.
  - 8. Proco Products, Inc.
  - 9. Tozen Corporation.
  - 10. Unaflex, Inc.
  - 11. Universal Metal Hose; a Hyspan company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

### **2.013 WATER METERS**

- A. Displacement-Type Water Meters:
  - 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. AALIAN; a Venture Measurement Product Line.
    - b. ABB.
    - c. Badger Meter, Inc.
    - d. Carlon Meter.
    - e. Mueller Company; Water Products Division.
    - f. Schlumberger Limited; Water Division.
    - g. Sensus Metering Systems.
  - 2. Description:
    - a. Standard: AWWA C700.
    - b. Pressure Rating: 150-psig working pressure.

- c. Body Design: Nutating disc; totalization meter.
- d. Registration: In gallons or cubic feet as required by utility.
- e. Case: Bronze.
- f. End Connections: Threaded.

B. Turbine-Type Water Meters:

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. AALIAN; a Venture Measurement Product Line.
  - b. ABB.
  - c. Badger Meter, Inc.
  - d. Hays Fluid Controls.
  - e. Master Meter, Inc.
  - f. McCrometer.
  - g. Mueller Company; Water Products Division.
  - h. Schlumberger Limited; Water Division.
  - i. SeaMetrics Inc.
  - j. Sensus Metering Systems.
2. Description:
  - a. Standard: AWWA C701.
  - b. Pressure Rating: 150-psig working pressure.
  - c. Body Design: Turbine; totalization meter.
  - d. Registration: In gallons or cubic feet as required by utility company .
  - e. Case: Bronze.
  - f. End Connections for Meters NPS 2 and Smaller: Threaded.
  - g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water Meters:

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. ABB.
  - b. Badger Meter, Inc.
  - c. Master Meter, Inc.
  - d. Mueller Company; Water Products Division.
  - e. Schlumberger Limited; Water Division.
  - f. Sensus Metering Systems.
2. Description:
  - a. Standard: AWWA C702.

- b. Pressure Rating: 150-psig working pressure.
  - c. Body Design: With integral mainline and bypass meters; totalization meter.
  - d. Registration: In gallons or cubic feet as required by utility company.
  - e. Case: Bronze.
  - f. Pipe Connections: Flanged.
- D. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

#### **2.014 ESCUTCHEONS**

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

#### **2.015 SLEEVES**

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

#### **2.016 SLEEVE SEALS**

- A. 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:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex, Inc.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

#### **2.017 GROUT**

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### **PART 3 - EXECUTION**

#### **3.01 EARTHWORK**

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.

- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX piping with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- T. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

### 3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Piping: Join according to ASTM D 2855.
- J. PEX Piping Joints: Join according to ASTM F 1807.

- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

#### **3.04 VALVE INSTALLATION**

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install ball valves in each hot-water circulation return branch.

#### **3.05 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

#### **3.06 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

#### **3.07 FLEXIBLE CONNECTOR INSTALLATION**

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

#### **3.08 WATER METER INSTALLATION**

- A. Rough-in domestic water piping for water meter installation, and install water meters according to utility company's requirements.
- B. Install water meters according to AWWA M6, utility company's requirements, and the following:
- C. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- D. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

### 3.09 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
  - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6: 12 feet with 3/4-inch rod.
  - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- G. Install supports for vertical steel piping every 15 feet.
- H. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.

2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
  3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
  4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  5. NPS 6: 48 inches with 3/4-inch rod.
  6. NPS 8: 48 inches with 7/8-inch rod.
- I. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
  - J. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
    1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
  - K. Install hangers for vertical PEX piping every 48 inches.
  - L. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
    1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
    2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
    3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
    4. NPS 6: 48 inches with 3/4-inch rod.
    5. NPS 8: 48 inches with 7/8-inch rod.
  - M. Install supports for vertical PVC piping every 48 inches.
  - N. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### **3.010 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.011 ESCUTCHEON INSTALLATION**

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw or spring clips.
5. Bare Piping in Equipment Rooms: One piece, cast brass stamped steel with set screw or spring clips.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

### **3.012 SLEEVE INSTALLATION**

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
  1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
  2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Stack sleeve fittings].
    - a. Extend sleeves 2 inches above finished floor level.
    - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
  3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Steel pipe sleeves for pipes smaller than NPS 6.
    - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

- c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- 4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE.
- 5. Sleeves for Piping Passing through Exterior Concrete Walls:
  - a. Steel pipe sleeves for pipes smaller than NPS 6.
  - b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
  - c. Do not use sleeves when wall penetration systems are used.
- 6. Sleeves for Piping Passing through Interior Concrete Walls:
  - a. PVC pipe sleeves for pipes smaller than NPS 6.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

### **3.013 SLEEVE SEAL INSTALLATION**

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.014 IDENTIFICATION**

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### **3.015 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

#### **C. Piping Tests:**

- 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
  6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.016 ADJUSTING**

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.017 CLEANING**

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.018 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
  1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
  2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; copper solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 socket fittings; and solvent-cemented joints.
  4. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.
  5. PEX Tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.

### **3.019 VALVE SCHEDULE**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
  - C. Iron grooved-end valves may be used with grooved-end piping.
  - D. CPVC valves matching piping materials may be used.

**END OF SECTION 221116**

## SECTION 221316

### SANITARY WASTE AND VENT PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

##### 1.04 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
  - 1. Solvent Drainage System: Include plans, elevations, sections, and details.

##### 1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

#### PART 2 - PRODUCTS

##### 2.01 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

##### 2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

##### 2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
  - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

#### PART 3 - EXECUTION

##### 3.01 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### **3.02 PIPING APPLICATIONS**

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
  - 1. Extra-Heavy class, cast-iron soil piping; calking materials; and calked joints.

### **3.03 PIPING INSTALLATION**

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

### 3.05 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- C. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
  - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialities."

### 3.06 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet : MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet , if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2 : 60 inches with 3/8-inch rod.
  - 2. NPS 3 : 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5 : 60 inches with 5/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet .
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.07 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### **3.08 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water . From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg . Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### **3.09 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

**END OF SECTION 221316**



## SECTION 221319

### SANITARY WASTE PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  1. Backwater valves.
  2. Cleanouts.
  3. Floor drains.
  4. Roof flashing assemblies.
  5. Through-penetration firestop assemblies.
  6. Miscellaneous sanitary drainage piping specialties.
  7. Flashing materials.

##### 1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

##### 1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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 NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

##### 1.06 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 size and location of roof penetrations.

## **PART 2 - PRODUCTS**

### **2.01 CLEANOUTS**

#### **A. Exposed Metal Cleanouts:**

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - g. Josam Company; Blucher-Josam Div.
4. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
5. Size: Same as connected drainage piping
6. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
7. Closure: Countersunk, cast-iron plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Closure: Stainless-steel plug with seal.

#### **B. Metal Floor Cleanouts:**

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.

- g. Zurn Plumbing Products Group; Light Commercial Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
  - i. Josam Company; Josam Div.
  - j. Kusel Equipment Co.
  - k. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - l. Josam Company; Blucher-Josam Div.
4. Standard: ASME A112.36.2M for adjustable housing cleanout.
  5. Size: Same as connected branch.
  6. Type: Adjustable housing.
  7. Body or Ferrule: Cast iron.
  8. Clamping Device: Not required.
  9. Outlet Connection: Spigot.
  10. Closure: Brass plug with straight threads and gasket.
  11. Adjustable Housing Material: Cast iron with threads.
  12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
  13. Frame and Cover Shape: Round.
  14. Top Loading Classification: Light Duty.
  15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
  16. Standard: ASME A112.3.1.
  17. Size: Same as connected branch.
  18. Housing: Stainless steel.
  19. Closure: Stainless steel with seal.
  20. Riser: Stainless-steel drainage pipe fitting to cleanout.
- C. Cast-Iron Wall Cleanouts:
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:
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.

4. Standard: ASME A112.36.2M. Include wall access.
5. Size: Same as connected drainage piping.
6. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
7. Closure: Countersunk, drilled-and-threaded brass plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
10. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

**D. Plastic Floor Cleanouts:**

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Canplas LLC.
  - b. IPS Corporation.
  - c. NDS Inc.
  - d. Plastic Oddities; a division of Diverse Corporate Technologies.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
3. Size: Same as connected branch.
4. Body: PVC.
5. Closure Plug: PVC.
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

**2.02 FLOOR DRAINS**

**A. Cast-Iron Floor Drains:**

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or a comparable product by one of the following:
  - a. Commercial Enameling Co.
  - b. Josam Company; Josam Div.
  - c. MIFAB, Inc.
  - d. Prier Products, Inc.
  - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - f. Tyler Pipe; Wade Div.

- g. Watts Drainage Products Inc.
- h. Zurn Plumbing Products Group; Light Commercial Operation.
- i. Zurn Plumbing Products Group; Specification Drainage Operation.

- 4. Pattern: Area or Floor drain.
- 5. Body Material: Gray iron.
- 6. Seepage Flange: Required.
- 7. Clamping Device: Required.
- 8. Coating on Interior and Exposed Exterior Surfaces: Not required.
- 9. Sediment Bucket: Not required.
- 10. Top or Strainer Material: Nickel bronze.
- 11. Top of Body and Strainer Finish: Nickel bronze.
- 12. Top Shape: Round.
- 13. Top Loading Classification: Light Duty.
- 14. Trap Material: Cast iron.
- 15. Trap Pattern: Deep-seal P-trap.
- 16. Trap Features: Trap Gard flapper.

### **2.03 ROOF FLASHING ASSEMBLIES**

#### **A. Roof Flashing Assemblies:**

- 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:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Acorn Engineering Company; Elmdor/Stoneman Div.
  - b. Thaler Metal Industries Ltd.

#### **B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.**

- 1. Open-Top Vent Cap: Without cap.
- 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
- 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

### **2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES**

#### **A. Through-Penetration Firestop Assemblies:**

- 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ProSet Systems Inc.
3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

## **2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

### **A. Air-Gap Fittings:**

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### **B. Sleeve Flashing Device:**

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### **C. Stack Flashing Fittings:**

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

### **D. Vent Caps:**

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

### **E. Frost-Resistant Vent Terminals**

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

### **F. Expansion Joints:**

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

## **2.06 FLASHING MATERIALS**

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
  2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
  3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
  1. General Applications: 12 oz./sq. ft..
  2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## **2.07 MOTORS**

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic conductors at floor penetrations.
- J. Assemble open drain fittings and install with top of hub 1 inch above floor.
- K. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- O. Install vent caps on each vent pipe passing through roof.
- P. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

- Q. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- R. Install wood-blocking reinforcement for wall-mounting-type specialties.
- S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 FLASHING INSTALLATION**

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### **3.04 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### **3.05 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled specialties and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**3.06 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION 221319**

## SECTION 221423

### STORM DRAINAGE PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:

- 1. Roof drains.

##### 1.03 SUBMITTALS

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

##### 1.04 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

#### PART 2 - PRODUCTS

##### 2.01 METAL ROOF DRAINS

- A. Metal, Medium-Sump, Promenade Roof Drains:

- 1. Standard: ASME A112.6.4, for promenade roof drains.
- 2. Body Material: Cast iron.
- 3. Dimension of Body: 11- to 12-inch diameter.
- 4. Dimension of Frame and Grate: Nominal 12 inches square.
- 5. Outlet: Bottom.
- 6. Grate Material: Cast iron.
- 7. Vandal-Proof Grate: Not required.
- 8. Extension Collars: Not required.
- 9. Underdeck Clamp: Required.
- 10. Expansion Joint: Not required.
- 11. Sump Receiver Plate: Required.

#### PART 3 - EXECUTION

##### 3.01 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
  - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Install expansion joints, if indicated, in roof drain outlets.
  - 3. Position roof drains for easy access and maintenance.

##### 3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

**3.03 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION 221423**

## SECTION 221429

### SUMP PUMPS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Submersible sump pumps.
  - 2. Wet-pit-volute sump pumps.
  - 3. Sump-pump basins and basin covers.
  - 4. Packaged drainage-pump units.
- B. Related Section:
  - 1. Division 22 Section "Sanitary Sewerage Pumps" for effluent and sewage pumps.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

##### 1.04 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

#### PART 2 - PRODUCTS

##### 2.01 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
  - 1. Description: Factory-assembled and -tested sump-pump unit.
  - 2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
  - 3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.

4. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, design for clear wastewater handling, and keyed and secured to shaft.
5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
6. Seal: Mechanical.
7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
  - a. Motor Housing Fluid: Air or Oil.
8. Controls:
  - a. Enclosure: NEMA 250, Type 1.
  - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
  - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
  - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches .
  - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
9. Controls:
  - a. Enclosure: NEMA 250, Type 1; wall-mounted.
  - b. Switch Type: Mercury-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
  - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
  - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Control-Interface Features:
  - a. Remote Alarm Contacts: For remote alarm interface.

## **2.02 SUMP-PUMP BASINS AND BASIN COVERS**

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
  1. Material: Fiberglass or Polyethylene.
  2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
  3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
  1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

### **2.03 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Motors for submersible pumps shall be hermetically sealed.

## **PART 3 - EXECUTION**

### **3.01 EARTHWORK**

- A. Excavation and filling are specified in Division 31 Section "Earth Moving."

### **3.02 EXAMINATION**

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

### **3.03 INSTALLATION**

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

### **3.04 CONNECTIONS**

- A. Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.06 STARTUP SERVICE**

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

**3.07 ADJUSTING**

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

**3.08 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

**END OF SECTION 221429**

## SECTION 223400

### FUEL-FIRED WATER HEATERS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
  - 1. Commercial, high-efficiency, gas water heaters.
  - 2. Compression tanks.
  - 3. Water heater accessories.

##### 1.03 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

##### 1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

##### 1.05 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

##### 1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.

- b. Faulty operation of controls.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): From date of Substantial Completion:
- a. Commercial, Gas Water Heaters:
    - 1) Storage Tank: Five years.
    - 2) Controls and Other Components: Three years.
  - b. Compression Tanks: One year(s).

## **PART 2 - PRODUCTS**

### **2.01 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.

### **2.02 COMMERCIAL, GAS WATER HEATERS**

- A. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
- 1. Manufacturer
    - a. Lochinvar
  - 2. Description: Manufacturer's proprietary design to provide at least 88 percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
  - 3. Storage-Tank Construction: Insulated glass lined steel tank.
    - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
  - 4. Factory-Installed, Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    - e. Jacket: Steel with enameled finish.
    - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and

include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.
6. Temperature Control: Adjustable thermostat.
7. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
8. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

### **2.03 COMPRESSION TANKS**

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
  1. Manufacturers:
    - a. AMTROL Inc.
    - b. Smith, A. O.; Aqua-Air Div.
    - c. State Industries, Inc.
  2. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
  3. Capacity and Characteristics:
    - a. Working-Pressure Rating: 100 psig.
    - b. Capacity Acceptable: 2 gal. minimum.
    - c. Air Precharge Pressure: 80 psig

### **2.04 WATER HEATER ACCESSORIES**

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- C. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
  1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
- D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.

### **2.05 SOURCE QUALITY CONTROL**

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

## **PART 3 - EXECUTION**

### **3.01 WATER HEATER INSTALLATION**

- A. Install commercial water heaters on concrete bases.
  - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
  - 2. Concrete base construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- F. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.
- I. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.
- J. Install pressure gage(s) on outlet piping of commercial, fuel-fired water heater piping. Refer to Division 15 Section "Meters and Gages" for pressure gages.
- K. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Valves" for general-duty valves and to Division 15 Section "Meters and Gages" for thermometers.
- L. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- M. Fill water heaters with water.
- N. Charge compression tanks with air.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

**3.03 DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters. Refer to Division 1 Section " Demonstration and Training."

**END OF SECTION 223400**



## SECTION 224000

### PLUMBING FIXTURES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Shower receptors.
7. Dishwasher air-gap fittings.
8. Disposers.
9. Water closets.
10. Urinals.
11. Lavatories.
12. Commercial sinks.
13. Individual showers.
14. Service sinks.

- B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."
4. Division 22 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

##### 1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. PVC: Polyvinyl chloride plastic.

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

#### **1.05 QUALITY ASSURANCE**

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
  - 4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
  - 5. Vitreous-China Fixtures: ASME A112.19.2M.
  - 6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  - 7. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.

3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  4. Faucets: ASME A112.18.1.
  5. Hose-Connection Vacuum Breakers: ASSE 1011.
  6. Hose-Coupling Threads: ASME B1.20.7.
  7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  8. NSF Potable-Water Materials: NSF 61.
  9. Pipe Threads: ASME B1.20.1.
  10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  11. Supply Fittings: ASME A112.18.1.
  12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
  4. Faucets: ASME A112.18.1.
  5. Hand-Held Showers: ASSE 1014.
  6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  7. Hose-Coupling Threads: ASME B1.20.7.
  8. Manual-Control Antiscald Faucets: ASTM F 444.
  9. Pipe Threads: ASME B1.20.1.
  10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
  11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1.
  3. Dishwasher Air-Gap Fittings: ASSE 1021.
  4. Manual-Operation Flushometers: ASSE 1037.
  5. Plastic Tubular Fittings: ASTM F 409.
  6. Brass Waste Fittings: ASME A112.18.2.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
  2. Dishwasher Air-Gap Fittings: ASSE 1021.

3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Shower Receptors: ANSI Z124.2.
10. Plastic Toilet Seats: ANSI Z124.5.
11. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### **1.06 WARRANTY**

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures of unit shell.
    - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

#### **1.07 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
  3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
  4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
  5. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
  6. Toilet Seats: Equal to 5 percent of amount of each type installed.
  7. Dry Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each Dry Urinal Trap-Seal Liquid: Equal to 1 gal for each urinal installed.

### **PART 2 - PRODUCTS**

**2.01 See fixture schedule on plans**

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

- S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- T. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### **3.03 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.04 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.05 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.06 CLEANING**

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.

2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

**3.07 PROTECTION**

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224000**



## SECTION 224700

### DRINKING FOUNTAINS AND WATER COOLERS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following water coolers and related components:
  - 1. Pressure water coolers.

##### 1.03 DEFINITIONS

- A. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of fixture.
- C. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- D. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

##### 1.04 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

##### 1.05 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

#### PART 2 - PRODUCTS

##### 2.01 PRESSURE WATER COOLERS

- A. Water Coolers, DF-1:
  - 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. 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. Elkay Manufacturing Co.
  - b. Halsey Taylor.
  - c. Haws Corporation.
  - d. Larco, Inc.
  - e. Oasis Corporation.
  - f. Sunroc Corp.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 APPLICATIONS**

- A. Use mounting frames for recessed water coolers, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

#### **3.03 INSTALLATION**

- A. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

#### **3.04 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**3.05 FIELD QUALITY CONTROL**

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
  - 1. Remove and replace malfunctioning units and retest as specified above.
  - 2. Report test results in writing.

**3.06 ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

**3.07 CLEANING**

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

**END OF SECTION 224700**



**DIVISION 23**  
**MECHANICAL**  
**INDEX**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
230500	Common Work Results for HVAC
230513	Common Motor Requirements for HVAC Equipment
230514	Variable Frequency Motor Controllers
230529	Hangers and Supports for HVAC Piping and Equipment
230548	Vibration Controls for HVAC Piping and Equipment
230553	Identification for HVAC Piping and Equipment
230593	Testing, Adjusting and Balancing for HVAC
230700	HVAC Insulation
230900	Instrumentation and Control for HVAC
233113	Metal Ducts
233300	Air Duct Accessories
233713	Diffusers, Registers and Grilles
237413	Packaged, Outdoor, Central-Station Air Handling Units



## SECTION 230500

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following:
  1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical sleeve seals.
  5. Sleeves.
  6. Escutcheons.
  7. Grout.
  8. Equipment installation requirements common to equipment sections.
  9. Painting and finishing.
  10. Concrete bases.
  11. Supports and anchorages.

##### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  1. CPVC: Chlorinated polyvinyl chloride plastic.
  2. PE: Polyethylene plastic.
  3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### **1.04 SUBMITTALS**

- A. Product Data: For the following:
  1. Transition fittings.
  2. Dielectric fittings.
  3. Mechanical sleeve seals.
  4. Escutcheons.
- B. Welding certificates.

#### **1.05 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes 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.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.07 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

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 manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## **2.02 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## **2.03 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  1. CPVC Piping: ASTM F 493.
  2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## **2.04 TRANSITION FITTINGS**

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  1. Manufacturers:
    - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:
    - a. Thompson Plastics, Inc.
  - C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
    1. Manufacturers:
      - a. NIBCO INC.
      - b. NIBCO, Inc.; Chemtrol Div.
- 2.05 DIELECTRIC FITTINGS**
- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
  - B. Insulating Material: Suitable for system fluid, pressure, and temperature.
  - C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
    1. Manufacturers:
      - a. Capitol Manufacturing Co.
      - b. Central Plastics Company.
      - c. Eclipse, Inc.
      - d. Epco Sales, Inc.
      - e. Hart Industries, International, Inc.
      - f. Watts Industries, Inc.; Water Products Div.
      - g. Zurn Industries, Inc.; Wilkins Div.
  - D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
    1. Manufacturers:
      - a. Capitol Manufacturing Co.
      - b. Central Plastics Company.
      - c. Epco Sales, Inc.
      - d. Watts Industries, Inc.; Water Products Div.
  - E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
    1. Manufacturers:
      - a. Advance Products & Systems, Inc.
      - b. Calpico, Inc.
      - c. Central Plastics Company.
      - d. Pipeline Seal and Insulator, Inc.
    2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

- a. Perfection Corp.
- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.
- d. Victaulic Co. of America.

## 2.06 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Metraflex Co.
- d. Pipeline Seal and Insulator, Inc.
- e. Linkseal Corp.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.07 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.08 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## **2.09 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
- a. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - b. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
  - c. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
  - d. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
  - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
  - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
  - a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
  - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
  - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
    - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe 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.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.02 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### **3.03 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

#### **3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

#### **3.05 PAINTING**

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

#### **3.06 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

#### **3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

#### **3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.09 GROUTING**

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 230500**



## SECTION 230513

### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

#### 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.
  4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

##### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 5200 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

##### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: NEMA premium efficiency motors.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  1. For motors with 2:1 speed ratio, consequent pole, single winding.
  2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.

- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### **2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

#### **2.5 SINGLE-PHASE MOTORS**

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

#### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 230513**

## SECTION 230514

### VARIABLE FREQUENCY MOTOR CONTROLERS

#### PART 1 GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections include the following:
  - 1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
  - 2. Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for low-voltage power, control, and communication surge suppressors.

##### 1.03 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFC: Variable frequency controller.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFC.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Nameplate legends.
    - c. Short-circuit current rating of integrated unit.
  - 2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.
- C. Qualification Data: For manufacturer and testing agency.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For VFCs, all installed devices, 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. Routine maintenance requirements for VFCs and all installed components.

#### **1.05 QUALITY ASSURANCE**

- A. **Manufacturer Qualifications:** A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. **Testing Agency Qualifications:** An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  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.
- C. **Source Limitations:** Obtain VFCs of a single type through one source from a single manufacturer.
- D. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

#### **1.07 PROJECT CONDITIONS**

- A. **Environmental Limitations:** Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
  1. Ambient Temperature: 0 to 40 deg C.
  2. Humidity: Less than 90 percent (noncondensing).
  3. Altitude: Not exceeding 6000 feet.

#### **1.08 COORDINATION**

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

### **PART 2 - PRODUCTS**

#### **2.01 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. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Baldor Electric Company (Graham).
3. Danfoss Inc.; Danfoss Electronic Drives Div.
4. Eaton Corporation; Cutler-Hammer Products.
5. General Electric Company; GE Industrial Systems.
6. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
7. Siemens Energy and Automation; Industrial Products Division.
8. Square D.
9. Toshiba International Corporation.

## **2.02 VARIABLE FREQUENCY CONTROLLERS**

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.

F. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
  2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
  3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 10 performance.
  4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
  5. Instantaneous line-to-line and line-to-ground overcurrent trips.
  6. Loss-of-phase protection.
  7. Reverse-phase protection.
  8. Short-circuit protection.
  9. Motor overtemperature fault.
- H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- K. Input Line Conditioning: Provide line reactors sized for 2.5% of drive size, reactor shall be integrally Factory mounted in VFD assembly. VFDs without built-in line reactors shall add a minimum 3% AC line reactors to the input of the VFD
- L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).

7. PID feedback signal (percent).
  8. DC-link voltage (VDC).
  9. Set-point frequency (Hz).
  10. Motor output voltage (V).
- O. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
  2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
    - a. 0 to 10-V dc.
    - b. 0-20 or 4-20 mA.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.
    - e. RS485.
    - f. Keypad display for local hand operation.
  3. Output Signal Interface:
    - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      - 1) Output frequency (Hz).
      - 2) Output current (load).
      - 3) DC-link voltage (VDC).
      - 4) Motor torque (percent).
      - 5) Motor speed (rpm).
      - 6) Set-point frequency (Hz).
  4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set-point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).
    - d. PID high- or low-speed limits reached.
- P. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
- Q. Integral Disconnecting Means: NEMA KS 1, nonfusible switch with lockable handle.

### 2.03 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Standard Displays:
  - 1. Output frequency (Hz).
  - 2. Set-point frequency (Hz).
  - 3. Motor current (amperes).
  - 4. DC-link voltage (VDC).
  - 5. Motor torque (percent).
  - 6. Motor speed (rpm).
  - 7. Motor output voltage (V).
- E. Historical Logging Information and Displays:
  - 1. Real-time clock with current time and date.
  - 2. Running log of total power versus time.
  - 3. Total run time.
  - 4. Fault log, maintaining last four faults with time and date stamp for each.

#### **2.04 FACTORY FINISHES**

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 APPLICATIONS**

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of controllers to suit motor controlled.

#### **3.03 INSTALLATION**

- A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

#### **3.04 IDENTIFICATION**

- A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

**3.05 CONNECTIONS**

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

**3.06 FIELD QUALITY CONTROL**

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
  - 3. Report results in writing.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. 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.

**3.07 ADJUSTING**

- A. Set field-adjustable switches and circuit-breaker trip ranges.

**3.08 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 262923**



## SECTION 230529

### HANGERS AND SUPPORTS FOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system equipment:
  - 1. Fastener systems.
  - 2. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 23 Section "Vibration and Seismic Controls for HVAC Equipment" for vibration isolation devices.
  - 2. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. Design seismic-restraint hangers and supports equipment and obtain approval from authorities having jurisdiction.

##### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Metal framing systems. Include Product Data for components.
  - 2. Equipment supports.
- C. Welding certificates.

##### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." or ASME Boiler and Pressure Vessel Code: Section IX.
- B. 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 D1.4, "Structural Welding Code--Reinforcing Steel."
  - 5. ASME Boiler and Pressure Vessel Code: Section IX.

## **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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. Masterset Fastening Systems, Inc.
    - d. MKT Fastening, LLC.
    - e. Powers Fasteners.

### **2.3 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

### **2.4 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.1 HANGER AND SUPPORT APPLICATIONS**

- A. Use hangers and supports with galvanized, metallic coatings for equipment that will not have field-applied finish.

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

### **3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.4 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.5 ADJUSTING**

- A. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.6 PAINTING**

- A. Touch Up: 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 230529**



## SECTION 230548

### VIBRATION CONTROLS FOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Isolation pads.
  - 2. Isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Restrained spring isolators.
  - 5. Spring hangers with vertical-limit stops.
  - 6. Restrained vibration isolation roof-curb rails.
  - 7. Restraining braces and cables.
  - 8. Steel and inertia, vibration isolation equipment bases.

##### 1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading: (Refer to the structural drawings for "Loading")

##### 1.05 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
3. Seismic- and Wind-Restraint Details:
  - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
  - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

#### **1.06 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on

independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## **PART 2 - PRODUCTS**

### **2.01 VIBRATION ISOLATORS**

- 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: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. California Dynamics Corporation.
  - 4. Isolation Technology, Inc.
  - 5. Kinetics Noise Control.
  - 6. Mason Industries.
  - 7. Vibration Eliminator Co., Inc.
  - 8. Vibration Isolation.
  - 9. Vibration Mountings & Controls, Inc.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
  - 1. Resilient Material: Oil- and water-resistant neoprene.
- E. Restrained Mounts: All-directional mountings with seismic restraint.
  - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  - 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
  1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## **2.02 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS**

- 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: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  1. Amber/Booth Company, Inc.
  2. California Dynamics Corporation.
  3. Isolation Technology, Inc.
  4. Kinetics Noise Control.
  5. Mason Industries.
  6. Thybar Corporation.
  7. Vibration Eliminator Co., Inc.
  8. Vibration Isolation.
  9. Vibration Mountings & Controls, Inc.
- D. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- E. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching

roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
  - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic[or wind restraint].
    - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
    - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
    - a. Resilient Material: Oil- and water-resistant standard neoprene.
- G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### **2.03 VIBRATION ISOLATION EQUIPMENT BASES**

- 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: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Amber/Booth Company, Inc.
  - 2. California Dynamics Corporation.
  - 3. Isolation Technology, Inc.
  - 4. Kinetics Noise Control.
  - 5. Mason Industries.
  - 6. Vibration Eliminator Co., Inc.
  - 7. Vibration Isolation.
  - 8. Vibration Mountings & Controls, Inc.
- D. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- E. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

#### **2.04 FACTORY FINISHES**

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  1. Powder coating on springs and housings.
  2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  3. Baked enamel or powder coat for metal components on isolators for interior use.
  4. Color-code or otherwise mark vibration isolation and seismic[- and wind]-control devices to indicate capacity range.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 APPLICATIONS**

- A. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### **3.03 VIBRATION-CONTROL DEVICE INSTALLATION**

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
  - 6. Measure isolator restraint clearance.

7. Measure isolator deflection.
  8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
  - E. Prepare test and inspection reports.

**3.05 ADJUSTING**

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- B. Adjust air-spring leveling mechanism.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

**3.06 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

**3.07 HVAC VIBRATION-CONTROL DEVICE SCHEDULE**

- A. Supported or Suspended Equipment: Refer to the drawings.

**END OF SECTION 230548**

## SECTION 230553

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

##### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### PART 2 - PRODUCTS

##### 2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
  - C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **cover full** circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches high.

## 2.04 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Yellow.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.05 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Aluminum.
  - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.06 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.07 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### **3.02 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

#### **3.03 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
  1. Identification Paint: Use for contrasting background.
  2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
  1. Refrigerant Piping:
    - a. Background Color: **White**.
    - b. Letter Color: **Red**.

#### **3.04 DUCT LABEL INSTALLATION**

- A. Install **plastic-laminated** duct labels with permanent adhesive on air ducts in the following color codes:

1. **Blue:** For cold-air supply ducts.
  2. **Yellow:** For hot-air supply ducts.
  3. **Green:** For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.05 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
    - a. Refrigerant: 1-1/2 inches, round.
  2. Valve-Tag Color:
    - a. Refrigerant: **Green**.
  3. Letter Color:
    - a. Refrigerant: Black.

### 3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 230553**



## SECTION 230593

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. HVAC equipment quantitative-performance settings.
3. Space pressurization testing and adjusting.
4. Indoor-air quality measuring.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of activities and procedures specified in this Section.

##### 1.03 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- K. TAB: Testing, adjusting, and balancing.

- L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

#### **1.04 SUBMITTALS**

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 6 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

#### **1.05 QUALITY ASSURANCE**

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. The Contract Documents examination report.
    - c. TAB plan.
    - d. Work schedule and Project-site access requirements.
    - e. Coordination and cooperation of trades and subcontractors.
    - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"

- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

#### **1.06 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

#### **1.07 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### **1.08 WARRANTY**

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

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

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
  - 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 5. Sensors are located to sense only the intended conditions.
  - 6. Sequence of operation for control modes is according to the Contract Documents.
  - 7. Controller set points are set at indicated values.
  - 8. Interlocked systems are operating.
  - 9. Changeover from heating to cooling mode occurs according to indicated values.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.02 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.
  - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

### 3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
  - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. **Compensating for Diversity:** When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. **Pressure-Independent, Variable-Air-Volume Systems:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  1. Set outside-air dampers at minimum and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record the final fan performance data.
- C. **Pressure-Dependent, Variable-Air-Volume Systems with Diversity:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow.

When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

### **3.07 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer, model, and serial numbers.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### **3.08 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Refrigerant Coils: Measure the following data for each coil:
  1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Refrigerant suction pressure and temperature.

### **3.09 PROCEDURES FOR TEMPERATURE MEASUREMENTS**

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.010 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS**

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
  - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
  - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
  - 3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
  - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
  - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
  - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

### **3.011 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS**

- A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.
- B. Observe and record the following conditions for each HVAC system:
  - 1. The distance between the outside-air intake and the closest exhaust fan discharge, cooling tower, flue termination, or vent termination.
  - 2. Specified filters are installed. Check for leakage around filters.
  - 3. Cooling coil drain pans have a positive slope to drain.
  - 4. Cooling coil condensate drain trap maintains an air seal.
  - 5. Evidence of water damage.
  - 6. Insulation in contact with the supply, return, and outside air is dry and clean.
- C. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
  - 1. Most remote area.
  - 2. One location per floor.
  - 3. One location for every 5000 sq. ft.

D. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:

1. Temperature.
2. Relative humidity.
3. Air velocity.
4. Concentration of carbon dioxide (ppm).
5. Concentration of carbon monoxide (ppm).
6. Nitrogen oxides (ppm).
7. Formaldehyde (ppm).

### **3.012 TEMPERATURE-CONTROL VERIFICATION**

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### **3.013 TOLERANCES**

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  2. Air Outlets and Inlets: 0 to minus 10 percent.

### **3.014 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.015 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB firm who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer, type size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
  - 15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.

- e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
- 1. Quantities of outside, supply, return, and exhaust airflows.
  - 2. Duct, outlet, and inlet sizes.
  - 3. Terminal units.
  - 4. Position of balancing devices.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
- 1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  - 2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.

- f. Preheat coil static-pressure differential in inches wg.
- g. Cooling coil static-pressure differential in inches wg.
- h. Heating coil static-pressure differential in inches wg.
- i. Outside airflow in cfm.
- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm
- b. Average face velocity in fpm
- c. Air pressure drop in inches wg
- d. Outside-air, wet- and dry-bulb temperatures in deg F
- e. Return-air, wet- and dry-bulb temperatures in deg F
- f. Entering-air, wet- and dry-bulb temperatures in deg F
- g. Leaving-air, wet- and dry-bulb temperatures in deg F
- h. Water flow rate in gpm
- i. Water pressure differential in feet of head or psig
- j. Entering-water temperature in deg F
- k. Leaving-water temperature in deg F

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.

- b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Fuel type in input data.
  - g. Output capacity in Btuh
  - h. Ignition type.
  - i. Burner-control types.
  - j. Motor horsepower and rpm.
  - k. Motor volts, phase, and hertz.
  - l. Motor full-load amperage and service factor.
  - m. Sheave make, size in inches, and bore.
  - n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Entering-air temperature in deg F.
  - c. Leaving-air temperature in deg F.
  - d. Air temperature differential in deg F.
  - e. Entering-air static pressure in inches wg.
  - f. Leaving-air static pressure in inches wg.
  - g. Air static-pressure differential in inches wg.
  - h. Low-fire fuel input in Btuh.
  - i. High-fire fuel input in Btuh.
  - j. Manifold pressure in psig.
  - k. High-temperature-limit setting in deg F.
  - l. Operating set point in Btuh.
  - m. Motor voltage at each connection.
  - n. Motor amperage for each phase.
  - o. Heating value of fuel in Btuh.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.

- e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
- a. Make and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
- a. System and air-handling unit number.
  - b. Location and zone.
  - c. Traverse air temperature in deg F
  - d. Duct static pressure in inches wg
  - e. Duct size in inches
  - f. Duct area in sq. ft.
  - g. Indicated airflow rate in cfm
  - h. Indicated velocity in fpm
  - i. Actual airflow rate in cfm
  - j. Actual average velocity in fpm
  - k. Barometric pressure in psig
- K. Air-Terminal-Device Reports:
1. Unit Data:
- a. System and air-handling unit identification.
  - b. Location and zone.

- c. Test apparatus used.
  - d. Area served.
  - e. Air-terminal-device make.
  - f. Air-terminal-device number from system diagram.
  - g. Air-terminal-device type and model number.
  - h. Air-terminal-device size.
  - i. Air-terminal-device effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm
  - b. Air velocity in fpm
  - c. Preliminary airflow rate as needed in cfm
  - d. Preliminary velocity as needed in fpm
  - e. Final airflow rate in cfm
  - f. Final velocity in fpm
  - g. Space temperature in deg F
- L. Indoor-Air Quality Measurement Reports for Each HVAC System:
- 1. HVAC system designation.
  - 2. Date and time of test.
  - 3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
  - 4. Room number or similar description for each location.
  - 5. Measurements at each location.
  - 6. Observed deficiencies.
- M. Instrument Calibration Reports:
- 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.016 INSPECTIONS

- A. Initial Inspection:
- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
  - 2. Randomly check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.

- b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
- c. Measure sound levels at two locations.
- d. Measure space pressure of at least 10 percent of locations.
- e. Verify that balancing devices are marked with final balance position.
- f. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
- 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
- 3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- 7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

**3.017 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

**END OF SECTION 230593**



## SECTION 230700

### HVAC INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

###### A. Section Includes:

1. Insulation Materials:
  - a. Cellular glass.
  - b. Flexible elastomeric.
  - c. Mineral fiber.
  - d. Polyisocyanurate.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

###### B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
  1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
  4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  6. Detail application of field-applied jackets.
  7. Detail application at linkages of control devices.
  8. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
1. Sample Sizes:
    - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
    - b. Sheet Form Insulation Materials: 12 inches square.
    - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
    - d. Sheet Jacket Materials: 12 inches square.
    - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.06 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### **1.07 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **PART 2 - PRODUCTS**

#### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cell-U-Foam Corporation; Ultra-CUF.
    - b. Pittsburgh Corning Corporation; Foamglas Super K.
  - 2. Block Insulation: ASTM C 552, Type I.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.
  - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
  - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.

- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket. For equipment applications, provide insulation without factory-applied jacket
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Apache Products Company; ISO-25.
    - b. Dow Chemical Company (The); Trymer.
    - c. Duna USA Inc.; Corafoam.
    - d. Elliott Company; Elfoam.
    - e. HiTherm
  - 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
  - 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
  - 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
  - 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    - a. Pipe Applications: ASJ-SSL.
    - b. Equipment Applications: ASJ-SSL.

## **2.02 FIRE-RATED INSULATION SYSTEMS**

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. CertainTeed Corp.; FlameChek.

- b. Johns Manville; Firetemp Wrap.
- c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
- d. Thermal Ceramics; FireMaster Duct Wrap.
- e. 3M; Fire Barrier Wrap Products.
- f. Unifrax Corporation; FyreWrap.
- g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

### **2.03 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- C. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- D. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

### **2.04 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-97.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
    - c. Marathon Industries, Inc.; 290.
    - d. Mon-Eco Industries, Inc.; 22-30.
    - e. Vimasco Corporation; 760.

- D. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-96.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- E. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- G. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- H. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Red Devil, Inc.; Celulon Ultra Clear.
    - e. Speedline Corporation; Speedline Vinyl Adhesive.

## 2.05 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.

## **2.06 LAGGING ADHESIVES**

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
  - 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; CP-52.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - c. Marathon Industries, Inc.; 130.
    - d. Mon-Eco Industries, Inc.; 11-30.
    - e. Vimasco Corporation; 136.
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  - 3. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 4. Color: White.

## **2.07 SEALANTS**

- A. Joint Sealants:
  - 1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products: Subject to compliance with requirements

B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.

1. provide one of the following
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following
  - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

## **2.08 FACTORY-APPLIED JACKETS**

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide one of the following
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## **2.09 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 0.03-inch thick; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- E. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

#### 2.010 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
  1. Products: Subject to compliance with requirements, provide one of the following
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - b. Compac Corp.; 110 and 111.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
  - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
- 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- D. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- E. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide one of the following
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.011 SECUREMENTS

### A. Bands:

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

- a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316 0.015 inch thick, 3/4 inch] wide with wing or closed seal.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
  4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the following
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; Cupped Head Weld Pin.
      - 3) Midwest Fasteners, Inc.; Cupped Head.
      - 4) Nelson Stud Welding; CHP.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      - 2) GEMCO; Perforated Base.
      - 3) Midwest Fasteners, Inc.; Spindle.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      - 2) GEMCO; Press and Peel.
      - 3) Midwest Fasteners, Inc.; Self Stick.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive-backed base with a peel-off protective cover.
  5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; RC-150.
      - 2) GEMCO; R-150.
      - 3) Midwest Fasteners, Inc.; WA-150.
      - 4) Nelson Stud Welding; Speed Clips.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

#### **2.012 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Pipe: Install insulation continuously through floor penetrations.
  - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.06 MINERAL-FIBER INSULATION INSTALLATION**

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
- B. The VOC content of all adhesives used shall be less than the current VOC content limits of the south coast air quality management district (SCAQMD) rule #1168 and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- C. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- D. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- E. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- F. Where PVDC jackets are indicated, install as follows:
  - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  - 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### **3.08 FIRE-RATED INSULATION SYSTEM INSTALLATION**

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

### **3.09 FINISHES**

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
  - B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
  - C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
  - D. Do not field paint aluminum or stainless-steel jackets.

### **3.010 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in nonconditioned space.
  4. Indoor, exposed return located in nonconditioned space.
  5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Items Not Insulated:
  1. Indoor supply air ducts located in conditioned spaces.
  2. Indoor return air and general exhaust air ducts.
  3. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  4. Factory-insulated flexible ducts.
  5. Factory-insulated plenums and casings.
  6. Flexible connectors.
  7. Vibration-control devices.
  8. Factory-insulated access panels and doors.

### 3.011 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft.
- B. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- C. Concealed, rectangular, supply-air duct insulation shall be [one of] the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- D. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- E. Exposed, supply-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- F. Exposed, return-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- G. Exposed, outdoor-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

### 3.012 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. PVC: 0.03 inches thick.
  - 2. Aluminum, Smooth: 0.016 inch

### 3.013 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. Painted Aluminum, Smooth: 0.016 inch thick.

2. Stainless Steel, Type 304 or 316, Smooth 2B Finish.

**END OF SECTION 230700**



## SECTION 230900

### INSTRUMENTATION AND CONTROL FOR HVAC

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
  - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
  - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

##### 1.03 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

##### 1.04 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
  - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
  - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
  - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
  - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
  - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
  - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - a. Water Temperature: Plus or minus 1 deg F.
  - b. Space Temperature: Plus or minus 1 deg F.
  - c. Ducted Air Temperature: Plus or minus 1 deg F
  - d. Outside Air Temperature: Plus or minus 2 deg F
  - e. Dew Point Temperature: Plus or minus 3 deg F
  - f. Temperature Differential: Plus or minus 0.25 deg F
  - g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
  - h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
  - i. Air Pressure (Space): Plus or minus 0.01-inch wg
  - j. Air Pressure (Ducts): Plus or minus 0.1-inch wg

#### **1.05 SEQUENCE OF OPERATION**

#### **1.06 SUBMITTALS**

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- 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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  3. Wiring Diagrams: Power, signal, and control wiring.
  4. Details of control panel faces, including controls, instruments, and labeling.
  5. Written description of sequence of operation.
  6. Schedule of dampers including size, leakage, and flow characteristics.
  7. Schedule of valves including flow characteristics.
  8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.

- c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
- 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
- 10. Controlled Systems:
  - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
  - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
  - c. Written description of sequence of operation including schematic diagram.
  - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.
- E. Samples for Initial Selection: For each color required, of each type of thermostat[ **or sensor**] cover with factory-applied color finishes.
- F. Samples for Verification: For each color required, of each type of thermostat[ **or sensor**] cover.
- G. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for DDC workstations and control systems.
- H. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- I. Qualification Data: For Installer and manufacturer.
- J. Field quality-control test reports.
- K. Operation and Maintenance Data: For HVAC instrumentation and control system 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. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 5. Calibration records and list of set points.

### **1.07 QUALITY ASSURANCE**

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- 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 ASHRAE 135 for DDC system components.

### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

### **1.09 COORDINATION**

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

### **1.010 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. Replacement Materials: One replacement diaphragm or relay mechanism for each unique pneumatic damper motor, valve motor, controller and thermostat positioning relay.

2. Maintenance Materials: Five thermostat adjusting key(s).
3. Maintenance Materials: One pneumatic thermostat test kit.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.02 CONTROL SYSTEM**

- A. Manufacturers:
  1. Alerton Inc.
  2. Andover Controls Corporation.
  3. Automated Logic Corporation.
  4. Delta Controls Inc.
  5. Honeywell International Inc.; Home & Building Control.
  6. Invensys Building Systems.
  7. Johnson Controls, Inc.; Controls Group.
  8. Siemens Building Technologies, Inc.
  9. tekmar Control Systems, Inc.
  10. Trane; Worldwide Applied Systems Group
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- D. Control system shall include the following:
  1. Building intrusion detection system specified in Division 28 Section "Intrusion Detection."
  2. Building clock control system specified in Division 27 Section "Clock Systems."
  3. Building lighting control system specified in Division 26 Section "Network Lighting Controls."
  4. Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."

### **2.03 DDC EQUIPMENT**

- A. Operator Workstation: Owner Supplied

1. Application Software:
  - a. I/O capability from operator station.
  - b. System security for each operator via software password and access levels.
  - c. Automatic system diagnostics; monitor system and report failures.
  - d. Database creation and support.
  - e. Automatic and manual database save and restore.
  - f. Dynamic color graphic displays with up to **10** screen displays at once.
  - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
  - h. Alarm processing, messages, and reactions.
  - i. Trend logs retrievable in spreadsheets and database programs.
  - j. Alarm and event processing.
  - k. Object and property status and control.
  - l. Automatic restart of field equipment on restoration of power.
  - m. Data collection, reports, and logs. Include standard reports for the following:
    - 1) Current values of all objects.
    - 2) Current alarm summary.
    - 3) Disabled objects.
    - 4) Alarm lockout objects.
    - 5) Logs.
  - n. Custom report development.
  - o. Utility and weather reports.
  - p. ASHRAE Guideline 3 report.
  - q. Workstation application editors for controllers and schedules.
  - r. Maintenance management.
2. Custom Application Software:
  - a. English language oriented.
  - b. Full-screen character editor/programming environment.
  - c. Allow development of independently executing program modules with debugging/simulation capability.
  - d. Support conditional statements.
  - e. Support floating-point arithmetic with mathematic functions.
  - f. Contains predefined time variables.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - d. Remote communications.
    - e. Maintenance management.
    - f. Units of Measure: Inch-pound and SI (metric).
  4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
  6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
  3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
  5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
  2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation[with three-position (on-off-auto) override switches and status lights].
  5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA)[with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer].
  6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
  2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
  2. Maximum response time of 10 nanoseconds.
  3. Minimum transverse-mode noise attenuation of 65 dB.
  4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.04 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.

3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
5. Enclosure: Dustproof rated for operation at 32 to 120 deg F
6. Retain subparagraph above for mounting in conditioned space; retain subparagraph below if outdoors or in wet ambient conditions.
7. Enclosure: Waterproof rated for operation at 40 to 150 deg F

## **2.05 ALARM PANELS**

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
  1. Alarm Condition: Indicating light flashes and horn sounds.
  2. Acknowledge Switch: Horn is silent and indicating light is steady.
  3. Second Alarm: Horn sounds and indicating light is steady.
  4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## **2.06 ANALOG CONTROLLERS**

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
  1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
  1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
  2. Proportional band shall extend from 2 to 20 percent for 5 psig.
  3. Authority shall be 20 to 200 percent.

4. Air-supply pressure of 18 psig , input signal of 3 to 15 psig , and output signal of zero to supply pressure.
5. Gages: **2-1/2 inches** in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

## 2.07 TIME CLOCKS

### A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with **8** separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

## 2.08 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

### B. Thermistor Temperature Sensors and Transmitters:

#### 1. Manufacturers:

- a. BEC Controls Corporation.
- b. Ebtron, Inc.
- c. Heat-Timer Corporation.
- d. I.T.M. Instruments Inc.
- e. MAMAC Systems, Inc.
- f. RDF Corporation.

2. Accuracy: Plus or minus **0.5 deg F** at calibration point.

3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, **18 inches** long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.

5. Averaging Elements in Ducts: **72 inches** long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.

6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  - a. Set-Point Adjustment: Concealed.
  - b. Set-Point Indication: Concealed.
  - c. Thermometer: Concealed
  - d. Color:
  - e. Orientation: Vertical
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. MAMAC Systems, Inc.
  - c. RDF Corporation.
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, **8 inches** [**18 inches** long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: 24 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches .
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  - a. Set-Point Adjustment: Concealed.
  - b. Set-Point Indication: Concealed.
  - c. Thermometer: Concealed.
  - d. Color:
  - e. Orientation: Vertical
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. General Eastern Instruments.
  - c. MAMAC Systems, Inc.

- d. ROTRONIC Instrument Corp.
  - e. TCS/Basys Controls.
  - f. Vaisala.
2. Accuracy: 2 percent full range with linear output.
  3. Room Sensor Range: 20 to 80 percent relative humidity.
  4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Concealed.
    - c. Thermometer: Concealed.
    - d. Color:
    - e. Orientation: Vertical.
  5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
  6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F
  7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. General Eastern Instruments.
  - c. MAMAC Systems, Inc.
  - d. ROTRONIC Instrument Corp.
  - e. TCS/Basys Controls.
  - f. Vaisala.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
  - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
  - b. Output: 4 to 20 mA.
  - c. Building Static-Pressure Range: 0- to 0.25-inch wg
  - d. Duct Static-Pressure Range: 0- to 5-inch wg
3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psi; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Concealed.
  2. Set-Point Indication: Concealed.
  3. Thermometer: Concealed.
  4. Color:
  5. Orientation: Vertical
- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
  2. Guards: Locking, solid metal, ventilated.
  3. Adjusting Key: As required for calibration and cover screws.

## **2.09 STATUS SENSORS**

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2 to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
  1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. I.T.M. Instruments Inc.

## **2.010 FLOW MEASURING STATIONS**

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
  1. Manufacturers:
    - a. Air Monitor Corporation.

- b. Wetmaster Co., Ltd.
  - c. Trane
  - d. Ebtron
2. Casing: Galvanized-steel frame.
  3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep.
  4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

## 2.011 THERMOSTATS

### A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

### B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches FAN HIGH-LOW-OFF".
2. Mount on single electric switch box.

### C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
  - a. Time of day.
  - b. Actual room temperature.
  - c. Programmed temperature.
  - d. Programmed time.
  - e. Duration of timed override.
  - f. Day of week.

- g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
  - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
  - 2. Selector Switch: Integral, manual on-off-auto.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
  - 1. Bulbs in water lines with separate wells of same material as bulb.
  - 2. Bulbs in air ducts with flanges and shields.
  - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
  - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
  - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
  - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
  - 1. Reset: Manual.
  - 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
  - 1. Bulb Length: Minimum 20 feet.
  - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
  - 1. Bulb Length: Minimum 20 feet.

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

## **2.012 HUMIDISTATS**

- A. Manufacturers:
  1. MAMAC Systems, Inc.
  2. ROTRONIC Instrument Corp.
- B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

## **2.013 ACTUATORS**

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
  5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
  2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm : Increase running torque by 1.5.

- f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  - 4. Coupling: V-bolt and V-shaped, toothed cradle.
  - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  - 7. Power Requirements (Two-Position Spring Return): 24-V ac.
  - 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  - 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  - 10. Temperature Rating: Minus 22 to plus 122 deg F.
  - 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
  - 12. Run Time: 12 seconds open, 5 seconds closed.
- C. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required and start-point adjustment[ **and positioning relay**]. Operator shall maintain full shutoff at maximum pump differential pressure.
- D. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Where actuators operate in sequence, provide pilot positioners.
- 1. Pilot Positioners: With the following characteristics:
    - a. Start Point: Adjustable from 2 to 12 psig.
    - b. Operating Span: Adjustable from 5 to 13 psig.
    - c. Linearity: Plus or minus 10 percent of output signal span.
    - d. Hysteresis: 3 percent of span.
    - e. Response: 0.25-psig input change.
    - f. Maximum Pilot Signal Pressure: 20 psig.
    - g. Maximum Control Air-Supply Pressure: 60 psig.
  - 2. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 deg F unless located in return-air plenums.
  - 3. Inlet-Vane Operators: High pressure, with pilot positioners.

## 2.014 CONTROL VALVES

- A. Manufacturers:
- 1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
  - 2. Erie Controls.
  - 3. Hayward Industrial Products, Inc.
  - 4. Magnatrol Valve Corporation.
  - 5. Neles-Jamesbury.
  - 6. Parker Hannifin Corporation; Skinner Valve Division.

7. Pneuline Controls.
  8. Sauter Controls Corporation.
- B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
  2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
  3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
  4. Sizing: **5-psig** maximum pressure drop at design flow rate or the following:
    - a. Two Position: Line size.
    - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
    - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
  5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
  6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
  2. Disc Type: Nickel-plated ductile iron.
  3. Sizing: 1-psig maximum pressure drop at design flow rate.
- E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
  3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.015 DAMPERS

- A. Manufacturers:

1. Air Balance Inc.
  2. Don Park Inc.; Autodamp Div.
  3. TAMCO (T. A. Morrison & Co. Inc.).
  4. United Enertech Corp.
  5. Vent Products Company, Inc.
- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  2. Operating Temperature Range: From minus 40 to plus 200 deg F Edge Seals, Standard Pressure Applications: Closed-cell neoprene:
  3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf, when tested according to AMCA 500D.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

#### **3.02 INSTALLATION**

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Mount compressor and tank unit on restrained spring isolators with 1-inch static deflection. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.
  1. Pipe manual and automatic drains to nearest floor drain.
  2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
  1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
  1. Entrances.
  2. Public areas.
  3. Where indicated.

- F. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- J. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."
- K. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- L. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- M. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

### **3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### **3.04 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
6. Test calibration of pneumatic and electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
7. Test each point through its full operating range to verify that safety and operating control set points are as required.
8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
9. Test each system for compliance with sequence of operation.
10. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
  - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
  - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
  - c. Verify that spare I/O capacity has been provided.
  - d. Verify that DDC controllers are protected from power supply surges.

- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.05 ADJUSTING

#### A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
  - a. Check analog inputs at 0, 50, and 100 percent of span.
  - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
  - c. Check digital inputs using jumper wire.
  - d. Check digital outputs using ohmmeter to test for contact making or breaking.
  - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
  - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
  - b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
  - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
  - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
  - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
  - b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

#### B. Adjust initial temperature and humidity set points.

- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

### 3.06 Control Points for all rooftop units and ERV-1 unit:

- 1) This section's cooperation with the Control Contractor section is required to assure the proper interface between the fan unit, which can be a packaged rooftop or any other type of fan unit with controls, and the Building Automation System (BAS).
- 2) The Control Contractor will coordinate with AHU manufacturer to ensure:
  - a) Communication protocols (via a gateway or similar interface) interact with the BAS.
  - b) All inputs and outputs required for the specified control sequences, alarms, and safeties are available.
  - c) All inputs and outputs are communicating accurately and reliable with the BAS.
- 3) The Control Contractor shall use the supplied terminal strip available to connect the internal controller with the BAS. BAS inputs and outputs including:
  - a) Analog inputs to unit controller from BAS
    - i. Discharge air temperature setpoint
    - ii. Outside air damper position setpoint or outside air CFM setpoint
    - iii. Supply air static pressure setpoint or fan speed signal setpoint
  - b) Analog outputs from unit controller to BAS
    - i. Discharge air temperature
    - ii. Mixed air temperature
    - iii. Return air temperature
    - iv. Fan speed or Hertz, for VFDs
    - v. Pressure drop across filter
    - vi. Damper positions
  - c) Binary inputs to unit controller from BAS
    - i. Fan start/stop
    - ii. Fire/smoke alarm
  - d) Binary outputs from unit controller to BAS
    - i. Fan status
    - ii. Heating unit status (if applicable)
    - iii. Compressor status (if applicable)
    - iv. All alarms

### 3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 230900**



## SECTION 233113

### METAL DUCTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

###### A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

###### B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

###### 1. Static-Pressure Classes:

- a. Supply Ducts (except in Mechanical Rooms): **1-inch wg.**
- b. Supply Ducts (Upstream from Air Terminal Units): **2-inch wg**
- c. Supply Ducts (Downstream from Air Terminal Units): **1-inch wg**
- d. Supply Ducts (in Mechanical Equipment Rooms): **2-inch wg**
- e. Return Ducts (Negative Pressure): **1-inch wg**
- f. Exhaust Ducts (Negative Pressure): **1-inch wg**

###### 2. Leakage Class:

- a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg
  - b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg
  - c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg
  - d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg
  - e. Retain seismic options and design criteria in paragraph below that are approved by authorities having jurisdiction.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of the following products:
1. Liners and adhesives.
  2. Sealants and gaskets.
  3. Seismic-restraint devices.
- B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Factory- and shop-fabricated ducts and fittings.
  3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  4. Elevation of top of ducts.
  5. Dimensions of main duct runs from building grid lines.
  6. Fittings.
  7. Reinforcement and spacing.
  8. Seam and joint construction.
  9. Penetrations through fire-rated and other partitions.
  10. Equipment installation based on equipment being used on Project.
  11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
  2. Joint and seam construction and sealing.
  3. Reinforcement details and spacing.
  4. Materials, fabrication, assembly, and spacing of hangers and supports.
  5. Design Calculations: Calculations for selecting hangers and supports.
- D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- E. Welding certificates.
- F. Field quality-control reports.

#### **1.05 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to "Structural Welding Code - Steel," for hangers and supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

### **PART 2 - PRODUCTS**

#### **2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: **G60**.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

#### 2.04 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation; Insulation Group.
  - b. Johns Manville.
  - c. Knauf Insulation.
  - d. Owens Corning.
  - e. Maximum Thermal Conductivity:
    - 1) Type I, Flexible:  $0.27 \text{ Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$  at 75 deg F mean temperature.
    - 2) Type II, Rigid:  $0.23 \text{ Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$  at 75 deg F mean temperature.
2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

- a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
- a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## **2.05 SEALANT AND GASKETS**

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
- 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Sealant: Modified styrene acrylic.
  - 3. Water resistant.
  - 4. Mold and mildew resistant.
  - 5. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 6. Service: Indoor and outdoor.
  - 7. Service Temperature: Minus 40 to plus 200 deg F.
  - 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
- 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.06 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.01 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### **3.02 SEAM AND JOINT SEALING**

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
  - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
    - a. Systems for residential occupancy.
    - b. Ducts that are located directly in zones they serve.
    - c. Ducts that have short runs from volume-control boxes to diffusers.
    - d. Return-air ceiling plenums.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."
  - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
    - a. Systems for residential occupancy.
    - b. Ducts that are located directly in zones they serve.
    - c. Ducts that have short runs from volume control boxes to diffusers.
    - d. Return-air ceiling plenums.

### **3.03 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### **3.04 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

#### **3.05 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

#### **3.06 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
  2. Test the following systems:
    - a. Supply air.
  3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  4. Test for leaks before insulation application.
  5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  1. Visually inspect duct system to ensure that no visible contaminants are present.
  2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

- a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.07 DUCT CLEANING

- A. Clean duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.08 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel:
- B. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: Galvanized steel.
- C. Liner:
  1. Supply- and Return-Air Ducts: **Fibrous glass, Type I 1 inch thick.**
- D. Elbow Configuration:
  1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION 233113**

## SECTION 233300

### AIR DUCT ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

###### A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Combination fire and smoke dampers.
7. Flange connectors.
8. Duct silencers.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct security bars.
15. Duct accessory hardware.

###### B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

##### 1.03 SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

###### B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.

- b. Manual volume damper installations.
  - c. Control damper installations.
  - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
  - e. Duct security bars.
  - f. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
  - D. Source quality-control reports.
  - E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### **1.04 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

#### **1.05 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. Fusible Links: Furnish quantity equal to 5 percent of amount installed.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: **G60**.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

#### **2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. American Warming and Ventilating; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.

4. Duro Dyne Inc.
  5. Greenheck Fan Corporation.
  6. Lloyd Industries, Inc.
  7. Nailor Industries Inc.
  8. NCA Manufacturing, Inc.
  9. Pottorff; a division of PCI Industries, Inc.
  10. Ruskin Company.
  11. SEMCO Incorporated.
  12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: **2000 fpm.**
- D. Maximum System Pressure: **2-inch wg.**
- E. Frame: **0.052-inch** thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.
- I. Blade Axles:
1. Material: Galvanized steel.
  2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Electric actuators.
  4. Chain pulls.
  5. Front of rear screens.
  6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

### **2.03 BAROMETRIC RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
  2. American Warming and Ventilating; a division of Mestek, Inc.

3. Cesco Products; a division of Mestek, Inc.
  4. Duro Dyne Inc.
  5. Greenheck Fan Corporation.
  6. Lloyd Industries, Inc.
  7. Nailor Industries Inc.
  8. NCA Manufacturing, Inc.
  9. Pottorff; a division of PCI Industries, Inc.
  10. Ruskin Company.
  11. SEMCO Incorporated.
  12. Vent Products Company, Inc.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: **2000 fpm**
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: **0.064-inch**- thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades:
1. Multiple, **0.025-inch** thick, roll-formed aluminum.
  2. Maximum Width: 6 inches.
  3. Action: Parallel.
  4. Balance: Gravity.
  5. Eccentrically pivoted.
- G. Blade Seals: Vinyl or Neoprene.
- H. Blade Axles: Galvanized steel.
- I. Tie Bars and Brackets:
1. Material: Aluminum.
  2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Bronze.
- L. Accessories:
1. Flange on intake.
  2. Adjustment device to permit setting for varying differential static pressures.

#### **2.04 MANUAL VOLUME DAMPERS**

- A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.

- c. Flexmaster U.S.A., Inc.
  - d. McGill AirFlow LLC.
  - e. METALAIRE, Inc.
  - f. Nailor Industries Inc.
  - g. Pottorff; a division of PCI Industries, Inc.
  - h. Ruskin Company.
  - i. Trox USA Inc.
  - j. Vent Products Company, Inc.
2. Standard leakage rating.
  3. Suitable for horizontal or vertical applications.
  4. Frames:
    - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 0.064 inch thick.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements,,:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. Flexmaster U.S.A., Inc.
    - d. McGill AirFlow LLC.
    - e. METALAIRE, Inc.
    - f. Nailor Industries Inc.
    - g. Pottorff; a division of PCI Industries, Inc.
    - h. Ruskin Company.
    - i. Trox USA Inc.

- j. Vent Products Company, Inc.
- 2. Standard leakage rating, with linkage outside airstream.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
  - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
- 6. Bearings:
  - a. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 7. Tie Bars and Brackets: Aluminum.

## **2.05 CONTROL DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Duro Dyne Inc.
  - 2. Flexmaster U.S.A., Inc.
  - 3. Greenheck Fan Corporation.
  - 4. McGill AirFlow LLC.
  - 5. METALAIRE, Inc.
  - 6. Nailor Industries Inc.
  - 7. Ruskin Company.
  - 8. Vent Products Company, Inc.
  - 9. Young Regulator Company.
- B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
  - 1. Hat shaped.
  - 2. Galvanized-steel channels, 0.064 inch thick.
  - 3. Mitered and welded corners.
- D. Blades:
  - 1. Multiple blades with maximum blade width of 8 inches.
  - 2. Opposed-blade design.
  - 3. Galvanized steel.

4. 0.064 inch thick.
  5. Blade Edging: Closed-cell neoprene edging.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch-diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Oil-impregnated bronze.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.

## **2.06 FIRE DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
  2. Arrow United Industries; a division of Mestek, Inc.
  3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. McGill AirFlow LLC.
  6. METALAIR, Inc.
  7. Nailor Industries Inc.
  8. NCA Manufacturing, Inc.
  9. PHL, Inc.
  10. Pottorff; a division of PCI Industries, Inc.
  11. Prefco; Perfect Air Control, Inc.
  12. Ruskin Company.
  13. Vent Products Company, Inc.
  14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 3 hours.
- E. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F and 212 deg F rated.

## **2.07 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, :
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Cesco Products; a division of Mestek, Inc.
  - 3. Greenheck Fan Corporation.
  - 4. Nailor Industries Inc.
  - 5. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- I. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- J. Leakage: Class II.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: two-position action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf .
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Test and reset switches, damper mounted.

**2.08 FLANGE CONNECTORS**

A. Manufacturers: Subject to compliance with requirements,:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

**2.09 DUCT SILENCERS**

A. Manufacturers: Subject to compliance with requirements,:

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
  2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
  3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
  4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, [G90] [G60 ] galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- H. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
  2. Film-lined type with fill material.
    - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression
    - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
  3. Lining: Mylar.
- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Flange connections.
  2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
  3. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Capacities and Characteristics: Refer to the drawings.

## **2.010 TURNING VANES**

- A. Manufacturers: Subject to compliance with requirements:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. METALAIRE, Inc.
  4. SEMCO Incorporated.
  5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.011 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pottorff; a division of PCI Industries, Inc.
  - 2. Ventfabrics, Inc.
  - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 3/4 inches deep.
- F. Wall-Box Cover-Plate Material: Steel.

## 2.012 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Cesco Products; a division of Mestek, Inc.
  - 3. Ductmate Industries, Inc.
  - 4. Flexmaster U.S.A., Inc.
  - 5. Greenheck Fan Corporation.
  - 6. McGill AirFlow LLC.
  - 7. Nailor Industries Inc.
  - 8. Pottorff; a division of PCI Industries, Inc.
  - 9. Ventfabrics, Inc.
  - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.

- b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.013 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd. .
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd.
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

## **2.014 FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation vapor-barrier film.
  - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 175 deg F.
- C. Flexible Duct Connectors:
  - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

## **2.015 DUCT ACCESSORY HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of

sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Adjacent to and close enough to fire or smoke dampers.
  - 3. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to low-pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### **3.02 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 233300**



## SECTION 233713

### DIFFUSERS, REGISTERS, AND GRILLES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

###### A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Linear bar diffusers.
3. Linear slot diffusers.
4. Adjustable bar grilles.
5. Fixed face grilles.
6. Linear bar grilles.

###### B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

##### 1.03 SUBMITTALS

###### A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

###### B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

###### C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

###### D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

###### E. Source quality-control reports.

## **PART 2 - PRODUCTS**

### **2.01 CEILING DIFFUSERS**

#### **A. Rectangular and Square Ceiling Diffusers:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Krueger.
  - b. METALAIRE, Inc.
  - c. Nailor Industries Inc.
  - d. Price Industries.
  - e. Titus.
3. Devices shall be specifically designed for variable-air-volume flows.
4. **Material:** Steel.
5. **Finish:** Baked enamel, white.

### **2.02 CEILING LINEAR SLOT OUTLETS**

#### **A. Linear Bar Diffuser:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings:
  - a. Krueger.
  - b. METALAIRE, Inc.
  - c. Nailor Industries Inc.
  - d. Price Industries.
  - e. Titus.
3. Devices shall be specifically designed for variable-air-volume flows.
4. **Material:** Steel.
5. **Finish:** Baked enamel, white.

#### **B. Linear Slot Diffuser:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings:
  - a. Krueger.

- b. METALAIRE, Inc.
  - c. Nailor Industries Inc.
  - d. Price Industries.
  - e. Titus.
3. Devices shall be specifically designed for variable-air-volume flows.
  4. Material - Shell: Steel.
  5. Material - Pattern Controller and Tees: Aluminum.
  6. Finish - Face and Shell: Baked enamel, white.
  7. Finish - Pattern Controller: Baked enamel, black.
  8. Finish - Tees: Baked enamel, white.

## **2.03     REGISTERS AND GRILLES**

### **A. Adjustable Bar Grille:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:

- a. Krueger.
- b. METALAIRE, Inc.
- c. Nailor Industries Inc.
- d. Price Industries.
- e. Titus.

3. Material: Steel
4. Finish: Baked enamel, white.
5. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
6. Core Construction: Integral.
7. Rear-Blade Arrangement: Horizontal spaced 1/2 inch (13 mm)] apart.
8. Frame: 1-1/4 inches (32 mm) wide.
9. Mounting: Countersunk screw.

### **B. Fixed Face Grille:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Krueger.
- b. Nailor Industries Inc.

- c. Price Industries.
    - d. Titus.
  - 3. Material: Steel.
  - 4. Finish: Baked enamel, white.
  - 5. Face Arrangement: Perforated core.
  - 6. Core Construction: Integral.
  - 7. Frame: 1-1/4 inches (32 mm) wide.
  - 8. Mounting: Countersunk screw.
- C. Linear Bar Grille:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Krueger.
    - b. Nailor Industries Inc.
    - c. Price Industries.
    - d. Titus.
  - 3. Material: Steel.
  - 4. Finish: Baked enamel, white.
  - 5. Face Arrangement: Perforated core.

#### **2.04 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas where diffusers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install diffusers and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.03 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713**



## SECTION 237413

### PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Direct-expansion cooling.
  - 2. Gas furnace.
  - 3. Economizer outdoor- and return-air damper section.
- B. Related Sections include the following:
  - 1. Division 23 Section "Packaged, Outdoor, Heating and Cooling Makeup Air-Conditioners" for outdoor equipment air conditioning 100 percent outdoor air to replace air exhausted from a building.

##### 1.03 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- E. VVT: Variable-air volume and temperature.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design RTU supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

##### 1.05 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- 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. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
  2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  3. Wind Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
- D. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members to which RTUs will be attached.
  2. Roof openings
  3. Roof curbs and flashing.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

#### **1.06 QUALITY ASSURANCE**

- A. ARI Compliance:
1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
  2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  2. Comply with ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. 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.

#### **1.07 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
  2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
  3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
  4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## 1.08 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. Fan Belts: One set for each belt-driven fan.
  - 2. Filters: One set of filters for each unit.

## PART 2 - PRODUCTS

### 2.01 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: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. AAON, Inc.
  - 2. Carrier Corporation.
  - 3. McQuay International.
  - 4. Trane; American Standard Companies, Inc.
  - 5. YORK International Corporation.

### 2.02 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 1. Exterior Casing Thickness: **0.052 inch** thick.
- C. Inner Casing Fabrication Requirements:
  - 1. Inside Casing: Galvanized steel, **0.034 inch** thick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
  - 1. Materials: ASTM C 1071, Type I.
  - 2. Thickness: **2 inch**.
  - 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
  - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.
  - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
  - 2. Drain Connections: Threaded nipple.
  - 3. Pan-Top Surface Coating: Corrosion-resistant compound.

### 2.03 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Propeller, shaft mounted on permanently lubricated motor.
- D. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

### 2.04 COILS

- A. Supply-Air Refrigerant Coil:
  - 1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
  - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  - 3. Coil Split: Interlaced.
  - 4. Baked phenolic coating.
  - 5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.
- B. Outdoor-Air Refrigerant Coil:
  - 1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
  - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  - 3. Baked phenolic coating.

### 2.05 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: Two.
- B. Compressor: Hermetic, reciprocating, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief[, and crankcase heater].
- C. Refrigeration Specialties:
  - 1. Expansion valve with replaceable thermostatic element.
  - 2. Refrigerant filter/dryer.
  - 3. Manual-reset high-pressure safety switch.
  - 4. Automatic-reset low-pressure safety switch.
  - 5. Minimum off-time relay.
  - 6. Automatic-reset compressor motor thermal overload.
  - 7. Brass service valves installed in compressor suction and liquid lines.
  - 8. Low-ambient kit high-pressure sensor.
  - 9. Hot-gas bypass solenoid valve with a replaceable magnetic coil.

## **2.06 AIR FILTRATION**

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - 1. Pleated: Minimum MERV 13.

## **2.07 GAS FURNACE**

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
  - 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel with a minimum thermal efficiency of 80 percent.
  - 1. Fuel: Natural gas.
  - 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
  - 3. High-Altitude Model: For Project elevations more than 2000 feet above sea level.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Venting: Gravity vented with vertical extension.
- E. Safety Controls:
  - 1. Gas Control Valve: Modulating.
  - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

## **2.08 DAMPERS**

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
  - 1. Damper Motor: Modulating with adjustable minimum position.
  - 2. Relief-Air Damper: Gravity actuated with bird screen and hood.

## **2.09 ELECTRICAL POWER CONNECTION**

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

## **2.010 CONTROLS**

- A. Control equipment and sequence of operation are specified on drawings
- B. Basic Unit Controls:
  - 1. Control-voltage transformer.
  - 2. Mounted Annunciator Panel for Each Unit:
    - a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
    - b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.

- c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

#### **2.011 ACCESSORIES**

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Low-ambient kit using variable-speed condenser fans for operation down to 35 deg F.
- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Coil guards of painted, galvanized-steel wire.

#### **2.012 CAPACITIES AND CHARACTERISTICS – Refer to the Drawings**

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger than supported equipment and minimum 6 inches above finished ground elevation.
  - 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 5. Use ~~3000~~ psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
- B. Equipment Mounting: Install RTUs on concrete base using restrained spring isolators. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
  - 1. Minimum Deflection: 3 inch.
- C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

#### **3.03 CONNECTIONS**

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in Division 23 Section "Facility Natural-Gas Piping" Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
1. Install ducts to termination at top of roof curb.
  2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
  4. Install return-air duct continuously through roof structure.

### **3.04 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:
1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

### **3.05 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.

9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
  - a. Start refrigeration system.
  - b. Do not operate below recommended low-ambient temperature.
  - c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
  - a. Measure gas pressure on manifold.
  - b. Inspect operation of power vents.
  - c. Measure combustion-air temperature at inlet to combustion chamber.
  - d. Measure flue-gas temperature at furnace discharge.
  - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
  - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.
  - c. Outdoor-air, dry-bulb temperature.
  - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.

- b. Return-air volume.
  - c. Relief-air volume.
  - d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
- a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
- a. High-temperature limit on gas-fired heat exchanger.
  - b. Low-temperature safety operation.
  - c. Filter high-pressure differential alarm.
  - d. Economizer to minimum outdoor-air changeover.
  - e. Relief-air fan operation.
  - f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

**3.06 CLEANING AND ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

**3.07 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 237413**



**DIVISION 26000  
ELECTRICAL SPECIFICATIONS**

**SCOPE:**

This section of the Specifications describes the electrical materials, equipment, and systems to be incorporated into the work and requirements for performing related work. The contractor shall furnish all materials, equipment and perform all labor necessary to fulfill the requirements of these specifications and all other documents. Please note that the \*\* in this document is for the consultants use and not for the contractor.

If there are conflicts between sections of this specifications and / or between this specifications and the project drawings or the specifications listed on the project drawings the following order of importance shall be followed by the contractor. When there is a conflict between sections of the book specifications, the contractor shall include in their bid the more costly option and then obtain clarification from the engineer prior to purchase and/or construction for that portion of the work. If the answer to the conflict is such that the engineer's directions to the contractor is for the least costly option, the contractor shall issue a credit to the project contract. If the conflict is between the book specifications and the project drawings, details or drawing specifications, the contractor shall bid the project per the project drawings, details and drawing specifications. If there is a conflict between portions of the project drawings, details or specifications the contractor shall include in their bid the more costly option and then obtain clarification from the engineer prior to purchase and/or construction for that portion of the work. If the answer to the conflict is such that the engineer's directions to the contractor is for the least costly option, the contractor shall issue a credit to the project contract. If there is an obvious error on the project drawings (especially on the power one-line diagram with respect to conduit and wire sizes and fill and panel amperage and voltage ratings), and the contractor does not bring this to the attention of the engineer prior to bid, the contractor shall be responsible for all additional costs associated with this modification to the drawings in order to meet the N.E.C.

With respect to fire alarm systems, the drawings and specifications list a manufacturer, and unless these drawings or specifications specifically state otherwise, most major manufacturers are acceptable that meet the specifications and quality specified. The project drawings and specifications indicate the intent of the system design. The contractor and manufacturer must include in their bid all material and labor as required to meet all local codes and requirements of the local inspectors.

**SECTION 26-0500  
GENERAL CONDITIONS**

**1.0 GENERAL**

**1.01 GENERAL CONDITIONS**

- A. Codes: Comply with requirements of the following codes. The latest edition that is presently accepted by the jurisdiction having authority over the project shall apply.
  - 1. National Electric Code (\*\*)
  - 2. National Fire Protection Association Codes (NFPA-101)
  - 3. Local Codes and Ordinances
  - 4. Fire District Codes and Requirements
  - 5. Uniform Building Code
  - 6. Special Codes or Requirements given to the Contractor by the Owner.
  - 7. National Electrical Safety Code
  - 8. NECA Standards of Installation

B. Permits: Obtain and pay for all necessary local and state permits in addition to having all work inspected by appropriate authorities.

C. Utilities:

1. Power Company: Verify and comply with all Power Company requirements for metering overhead and/or underground pull sections, transformer pads, primary and secondary conduit requirements. Contractor shall have the local Power Company review the final switchgear submittal drawings and give approval on the utility sections on the equipment prior to purchase and delivery of the equipment. The Power Company shall provide and install the padmount transformer, concrete pad, meter installation, primary and secondary transformer terminations, primary conductor, trenching and backfill for their primary service, contractor to verify and shall furnish and install any of the above that the utility does not perform. The contractor shall furnish and install the C.T. Cabinet (if separate piece of equipment) plus mount any C.T.'s furnished by the utility company. The Power Company shall provide the meter socket for the contractor to install. Coordinate the exact location of the Power Company transformer. These requirements are specific for most utility companies. The contractor will modify their bid to comply with the local utility company requirements.

**THIS CONTRACTOR SHALL SUBMIT ELECTRICAL DRAWINGS IMMEDIATELY TO THE LOCAL UTILITY COMPANY FOR THEIR REVIEW. IF THERE ARE ANY UTILITY CHARGES, THEY SHALL BE PAID BY THE OWNER BUT THIS CONTRACTOR SHALL PROVIDE ALL COORDINATION BETWEEN THE OWNER AND THE UTILITY COMPANY AND THIS SHALL BE ACCOMPLISHED IN AN IMMEDIATE MANNER ONCE THE PROJECT IS AWARDED TO THE CONTRACTOR. COORDINATE ALL UTILITY CHANGES THAT ARE TO TAKE PLACE ON THIS CONTRACT WITH RESPECT TO THE ELECTRICAL WORK THAT IS GOING TO BE PERFORMED.**

2. Telephone Company: Verify and comply with all requirements and conditions of the local telephone company concerning the complete telephone system.

**THIS CONTRACTOR SHALL SUBMIT ELECTRICAL DRAWINGS IMMEDIATELY TO THE LOCAL TELEPHONE COMPANY FOR THEIR REVIEW. IF THERE ARE ANY TELEPHONE CHARGES, THEY SHALL BE PAID BY THE OWNER BUT THIS CONTRACTOR SHALL PROVIDE ALL COORDINATION BETWEEN THE OWNER AND THE TELEPHONE COMPANY AND THIS SHALL BE ACCOMPLISHED IN AN IMMEDIATE MANNER ONCE THE PROJECT IS AWARDED TO THE CONTRACTOR. COORDINATE ALL TELEPHONE CHANGES THAT ARE TO TAKE PLACE ON THIS CONTRACT WITH RESPECT TO THE ELECTRICAL WORK THAT IS GOING TO BE PERFORMED.**

D. Substitution:

1. Where materials are specified on the Contract Drawings by manufacturer and part number, only such material of the same quality shall be provided unless otherwise approved by the Architect or unless otherwise specified. The engineer's decision is final concerning whether or not the substituted item is equal to the specified item.
2. If the contractor wishes to make any substitutions, he shall, before any materials or equipment are purchased, submit to the Architect for approval a list of proposed substitutes. List shall include data on the substitutions offered, including the amount of change in the Contract Price, if any, which would result from the substitutions. The burden of proof of equality of materials or equipment shall rest with the contractor. The contractor shall bear any time delays, if any, due to the substitution process.
3. Trade names and/or manufacturer model numbers indicated in the Contract Drawings or in these Specifications are provided to establish standards for types and construction of items.
4. Approval by the Architect shall not relieve the Contractor from liability for latent defects in work and materials. The decision of the Architect as to quality of the substitutes shall be final.
5. When the SUBSTITUTED submittal drawings are presented to the architect for their review, the contractor shall also present a letter stating in great detail the differences between the specified items and the substituted items. If these are not presented, this will be grounds for an immediate rejection of the submittals. If this letter does not include all items that are different and they are discovered

during the submittal and/or construction process, this contractor shall be responsible for all associated costs to make the installation complete and per the plans and specifications.

E. Coordination:

1. The Contract Drawings indicate the extent, the general locations, arrangement of equipment, conduit and wiring and must not be scaled for exact locations. The contractor shall review all architectural and mechanical drawings prior to any roughin to determine location of all electrical items specifically shown on those drawings especially concerning dimensions if so included.
2. Verify all architectural and construction dimensions and make necessary changes to conform to the building as constructed. Work improperly installed due to lack of construction verification shall be corrected at the contractor's expense.
3. Keep on hand at the job site at all times: a complete set of project drawings, project specifications, current edition of the National Electric Code, local codes and ordinances, and approved shop drawings / submittals.
4. Contractor shall study the complete set of project plans and details so that the outlets and equipment will be properly located to avoid interference with mechanical or structural arrangement. If any conflicts occur necessitating departure from the contract drawings, details of departures and reasons therefore shall be submitted as soon as practicable for written approval.
5. The contractor shall visit the job site of this project in order to fully understand the facilities, difficulties and restrictions attending the execution of the work. No additional compensation will be allowed this contractor for work or items omitted from their original proposal due to their failure to inform themselves regarding such matters affecting the installation & design included in these documents.
6. The contractor shall review the mechanical and architectural drawings and specifications to determine the level of coordination required in order to provide a complete fully functional project.
7. The contractor shall provide full coordination between themselves and the mechanical installer with respect to the installation of all panels, switchgear, transformers etc. and the mechanical installer's ductwork and piping. The contractor shall ensure that the mechanical installer DOES NOT install any ductwork and/or piping within the dedicated electrical equipment space as called for in the National Electrical Code.
8. The contractor shall provide full coordination between themselves and the mechanical installer with respect to the lighting and the installation of the project's ductwork and/or piping to allow for the installation of the light fixtures as shown on the electrical drawings. This coordination shall also apply between this contractor and the installer of the ceiling systems to ensure that proper space is allowed for the installation of all light fixtures.
9. If the above coordination is not done the contractor shall be responsible for all costs associated with correcting the conflicts.

F. Capacities:

The capacities of the equipment and material shall be not less than those indicated.

G. Workmanship:

All materials and equipment shall be installed in accordance with recommendations of the manufacturer as approved by the Architect, to conform with the Contract Documents. The installation shall be accomplished by workmen skilled in this type of work.

H. Unusual Service Conditions:

All items furnished under this section shall be specifically suitable for the following unusual service conditions:

1. Altitude \*\* (per local conditions) feet above sea level unless the actual project site is at a lower elevation and then that altitude level shall prevail.

I. Submittals:

1. Submit(6)six copies of all required material for approval.
2. Shop drawings for each item shall be submitted and not limited to, distribution equipment, switchboards and panelboards, lighting fixtures, signal systems and equipment as called for in the specifications. Resubmittal of shop drawings shall be made of corrected drawings.
3. Within (30) thirty days after the Contract has been awarded, forward to the Architect a complete list of all materials and equipment proposed for installation. The intent to use the exact makes specified does not eliminate the responsibility of submitting such a list. List shall include sufficient information to permit ready identification.
4. Contractor shall have submittals approved prior to installation of material.
5. Provide equipment layout plans, drawn to scale, and showing the space arrangement of electrical spaces such as main service switchboard area, electrical closets, fan rooms and mechanical rooms, and each area where electrical distribution equipment is to be installed Submit equipment layout plans for review with shop drawings. If this is not done and their are conflicts at a later date, the contractor will be fully responsible for all associated costs to correct.

J. As Built Drawings:

1. At completion of the project, furnish to the Architect, one set of "As-built" record prints for work included in this Section. "As-built" prints shall be in the form of durable transparencies which shall be of the same size as Construction Drawings. The "As-built" Drawings shall be on site and updated from the beginning of construction by redlining a set of normal drawings prior to making the final transparencies.
2. When the project drawings are produced on a CAD Computer System, the contractor shall submit all as-built drawings on computer disk that match the system on which they were drawn. The contractor may obtain an original set of computer documents from the engineer on which on as-builts can be recorded. These as-builts will include all contractor received change orders, architectural changes and changes generated by the contractor. When these as-builts are completed they shall be a complete set of finished documents.
3. Any deviation in details, locations, etc., from that indicated on the contract drawings shall be clearly indicated. Additions and/or changes shall be shown in red and removals shall be shown in green.

K. Safety

The contractor shall be responsible for the safety of his employees. Where contractor personnel are required for work in areas requiring protective equipment, such as safety glasses, ear plugs, respirators, and so forth, the contractor shall provide these items for his employees.

L. Punch List by Engineer

The contractor shall notify the engineer in writing that they are ready to have the engineer visit the site to review the installation and to prepare an electrical punch list. This letter will state as to what percentage of the work is complete. The engineer will visit the site (if required by their contractor with the architect and/or owner) and prepare this list. If the job is NOT 98% complete or greater and the engineer must make another trip, this additional cost will be paid by the contractor to the engineer. This same is also true if the engineer must make another trip to the site to verify that the contractor has completed the punch list items.

## 2.00 PRODUCTS

### 2.01 STANDARDS FOR MATERIALS AND EQUIPMENT

- A. Material, apparatus and equipment shall be new and shall bear the UL Label when such labels are applicable.
- B. Publications and Standards of Organizations as to their abbreviations and hereafter shown, shall be listed as follows:
  - 1. "UL" Underwriter's Laboratory
  - 2. "IPECA" Insulated Power Cable Engineers Assoc.
  - 3. "NEMA" National Electrical Manufacturers Assoc.
  - 4. "NFPA" National Fire Protection Assoc.
  - 5. "IEEE" Institute of Electrical & Electronic Engrs
  - 6. "ANSI" American National Standards Institute
- C. Where operating and maintenance instruction manuals are required, such manuals shall be bound in a vinyl three ring binder and submitted in triplicate.
- D. All similar materials and equipment shall be the product of the same manufacturer.

## **2.02 MATERIALS NOT FURNISHED UNDER THIS DIVISION**

Motors, hoists, hoist cable reels, electric heating equipment control devices (except those devices in motor control centers), and telephone wiring are not furnished under this Division of the Specification, unless otherwise noted on the drawings.

## **3.00 EXECUTION**

### **3.01 COOPERATION**

Schedule the work and cooperate with all trades to avoid delays, interference's and unnecessary work. If any conflicts occur necessitating departures from the drawings and specifications, details of departures and reasons therefore shall be submitted immediately for Architect consideration.

### **3.02 CERTIFICATION AND TESTS**

- A. Submit written certification that the electrical systems are complete and operational. Submit certification with contractor's request for final review.
- B. At the time of final review of electrical work, demonstrate the operation of the electrical systems. Furnish labor, apparatus and equipment for systems demonstration.
- C. After demonstration of system, turn over to the Owner: one set of final electrical operational and maintenance manuals, and keys for electrical equipment locks, plus any other items so indicated in these specifications.
- D. Thoroughly test all power and distribution circuits for proper operating conditions and freedom from grounds and short circuits before acceptance is requested. All equipment and devices shall be operated under load conditions.
- E. After the wiring system installation is complete and at such time as the Architect may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices, and equipment after installation, to assure that all material continues to possess all the original characteristics as required by governing codes and standards listed in these Specifications.
- F. After all terminations of any transformers, equipment, panels, enclosures, etc. have been made, they shall be verified for correct phase sequence by producing a 1-2-3 rotation on a phase sequence tester when connected to "A", "B", and "C" phases.
- G. After occupancy of the building has taken place and nominal building power loads established, make voltage readings, make final adjustments of tap changers on all transformers in the building as directed.

- H. Perform such other tests as required by other Sections of these Specifications or as requested to prove acceptability.
- I. Furnish all instruments and labor for testing.

### **3.03 OPERATING AND MAINTENANCE MANUALS**

- A. Instruction, Operation and Maintenance Manuals shall be furnished without additional charge to the owner, furnish complete instruction to the Owner in the care, adjustment, and operation of all parts of the electrical system.
- B. Upon completion of the work prepare and deliver to the Owner three (\*\*) sets of complete operating and maintenance manuals for the systems and major equipment provided by the contractor. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists, and manufacturer's operating and maintenance data.
- C. The above requirements are in addition to specific instruction and manuals specified for individual systems or equipment.

### **3.04 EQUIPMENT REQUIREMENTS**

The electrical requirements for equipment specified or indicated on the Contract Drawings are based on information available at the time of design. If equipment furnished for installation has electrical requirements other than indicated on the electrical drawings or electrical specifications, the contractor shall contact the Architect for resolution prior to proceeding with work affected by the changed requirements.(\*\*)

### **3.05 CUTTING AND PATCHING**

Carefully lay out all work in advance. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for proper installation, support or anchorage of raceways, outlets or other electrical equipment, this work shall be the responsibility of this contractor. Any damage to building, piping, equipment or defaced finish, plaster, woodwork or metalwork shall be repaired by skilled craftsmen of trades involved, at no additional cost to the Owner. Do no cutting, channeling, drilling, welding of structural members of building, etc., without first obtaining approval from Architect. If approval is granted, perform work in a manner acceptable to the Architect.

### **3.06 ESCUTCHEONS**

Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. The contractor shall caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U. S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

### **3.07 ACCESS DOORS**

Where ever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, a hinged access door and frame with flush latch handle shall be furnished and installed by the contractor. Review Architectural Specifications for material and installation requirements.

### **3.08 PAINTING**

All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. This contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

### **3.09 DIFFERING EQUIPMENT**

When any electrical and/or electrically driven equipment furnished under this or other sections of these specifications differs from the design shown, and/or the electrical contractor requests and obtains approval for a

substitution for equipment that differs from the original design, the contractor shall be responsible for the necessary adjustment to the conduit, wiring, disconnect and/or control devices, branch circuit protection and space considerations to accommodate the equipment installed without additional cost to the owner.

### **3.10 CLEAN-UP**

Upon completion of the work, remove materials, scrap, etc. relative to the electrical installation, and leave the premises in a clean, orderly condition. Clean electrical equipment and materials of foreign matter. Clean light fixtures using methods and materials recommended by the manufacturer.

### **3.11 DUCT SMOKE DETECTORS**

When a project does not include a complete fire alarm detection system, this contractor shall furnish all required duct smoke detectors for all air handling units rated at 2000cfm or greater. This will include units in both the supply and return air ducts. If the mechanical drawings and/or specifications state they duct detectors are included with the units the Division 16 contractor does not have to furnish them. In either case the Division 16 contractor will install and wire the units as required by code including all interconnect control wiring for auto shutdown. The contractor will furnish and install required test station and indicating light with all required wiring. This test switch and indicating light shall be located as allowed by the local fire department.

### **3.12 WARRANTY**

Provide a written warranty to the Owner covering the entire electrical work to be free from defective materials and workmanship for a period of one year after Date of Acceptance or date of beneficial occupancy, whichever comes first. During this period, provide labor and materials as required to repair or replace defects at no additional cost to the Owner. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Architect.

**END OF SECTION**



## SECTION 26-0519

### CONDUCTORS, LOW VOLTAGE (600 VOLTS OR LESS)

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. All conductors shall be 600 volt, crosslinked polyethylene or thermoplastic insulated copper of 98% conductivity, single conductor unless otherwise indicated. Every coil of wire shall be in the original wrapping when delivered to the job site unless otherwise accepted by the Architect.
- B. Aluminum conductors are not acceptable unless specifically indicated on the drawings as to size and type of conductors. If so indicated, each conductor shall be terminated at both ends with Hyplug Type Connectors with oxide inhibitor.\*\*)
- C. The items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 MATERIALS

- A. Feeder circuit conductors (#4 and larger) shall be 75 Degree C type "THW" or "XHHW" unless otherwise noted on drawings.
- B. Motor circuit conductors shall be 75 Degree C type "THW" or "XHHW", from the disconnecting means to the motor or for the complete circuit.
- C. Branch circuit conductors shall be a minimum of #12 AWG, and shall be 75 Degree C type "THHN/THWN".
- D. Conductor sizes #12 and #10 AWG shall be solid or stranded, #8 and larger shall be stranded. For motor circuits and motor control circuit conductors, (from the motor disconnect to the motor or controller), #12 and larger shall be stranded.
- E. Wire shall be sized for loading, length of runs and length between outlets as recommended by N.E.C.
- F. "Class 1" remote-control and signal circuit conductors shall be not less than #14AWG, type "TF" insulation. "Class 2" circuit conductors shall be not less than #16 AWG, type "TF" insulation.
- G. Branch circuit conductors inside lighting fixtures shall be stranded and type "THWN", "THHN-MTW" or equal, minimum of 90 Degree C, 600 volt, size #14 AWG.
- H. Conductor manufacturers shall be General Cable, Triangle, General Electric, Anaconda, Okonite, Rome or Phelps Dodge.
- I. Sizes shall be not less than indicated. Conductors for branch circuits of 120 volts, more than 100 feet long from the panel to the center of the load, shall be not less than #10 AWG.
- J. Control conductors shall be copper, minimum size #14, with 19/25 stranding, color-coded type "THHN-MTW".
- K. Communication and electronic cable shall be as required or specified in these specifications and/or on the contract drawings.
- L. Connectors and lugs for copper conductors #10 and smaller shall be #3M Scotch-Lok or T&B Stakon, or equal compression type connectors with integral or separate insulating caps.
- M. Connectors and lugs for copper conductors larger than #10 shall be T&B Series 54000 or equal.

- N. Splices involving #10 and smaller conductors in branch circuits can be made with ideal "wing-nuts", T&B "Wire Nuts", or crimp type insulated splices. Splices will only be allowed in outlet boxes or junction boxes.
- O. Splices involving #8 and larger conductor are not allowed unless so indicated on the drawings. When allowed the splice shall be T&B Series with heat shrink sleeves or hand-taped per manufacturer's recommendations.
- P. Heat shrink sleeves shall be T&B Series HB "SHRINK-KON" sized for conductors being spliced.
- Q. Plastic tape, 8.5 mils maximum thickness, 1,000,000 megohms minimum insulation resistance, oil-resistant vinyl backing, oil-resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.
- R. Wire pulling lubricant shall be Polywater Cable Lubricant.

### 3.00 EXECUTION

- A. When so indicated on the drawings or specified in this documents, all conduit have been sized based upon using THHN/THWN and/or XHHW copper conductors. If the contractor chooses to use the other specified type of conductors, it shall be their responsibility to increase the conduit sizes per N.E.C. at no additional cost.
- B. Conductors shall be installed in conduit. The number of conductors installed in any conduit shall not be greater than the number for which the conduit is approved.
- C. Conductors shall be continuous from outlet to outlet and from outlet to junction box. No joints or splices in conductors will be allowed in the conduit.
- D. No conductors shall be pulled into conduit until the conduit system is complete and weather tight.
- E. Connections, when required, to all circuit breakers, disconnect switches, to the mains in all panels, tags and splices in all conductors shall be made with solderless lugs and connectors.
- F. Connections at fixture outlet boxes and within fixtures shall be made with "Crimp" types.
- G. Insulation on branch circuit conductors #10 and smaller throughout the electrical system shall be color-coded. Conductors #8 and larger shall be color-coded with one inch wide colored tape, with tape applied at each end of conductor and at each point where conductor is accessible so as to be visible within the enclosure. Color-coding for each phase, neutral and ground wire shall conform to the electrical code.

120/208 Volt System

Phase A - Black

Phase B - Red

Phase C - Blue

Neutral - White Neutral- Gray

Ground - Green Ground - Green / yellow strip

- H. Where outlets are indicated, leave 6 inch leads of conductors for connection to devices.
- I. After pulling-in, and prior to connecting, all branch circuit conductors shall be rung for continuity and ground. Open or grounded conductors are to be replaced.
- J. After pulling-in, and prior to connecting, all feeder conductors shall be megged for grounds. Open or grounded conductors are to be replaced. A composite list of all feeders shall be made with meggar readings and turned over to the Architect.
- K. Identification of all conductors (both power and control) shall be exactly as called for on the drawings and control diagrams. Type of ID shall be submitted for approval. Conductor

identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. The tagging system shall be as manufactured by Grafoplast Wiremarkers Inc. (Phone Number 1-800-864-3874) or equal.

- L. Radius of bends shall not be less than 10 times the outer diameter of the cable.
- M. Bushing or clamp type strain relief fittings shall be used whenever cords or drop cables enter enclosures or connector devices.
- N. Kellum grips shall be applied for strain relief whenever flexible cords or drop cables are used for overhead drops. Grips shall be sized as indicated on the Contract Drawings.
- O. Kellum grips shall be used for strain relief whenever any conductors rise vertically 50 feet or more and reused every 50 feet of vertical rise.
- P. Tag feeder circuits in each enclosure with wrap-around circuit designation labels where feeder passes through or terminates in the enclosure.
- Q. Branch circuits can be multi-wire two, three and four wire circuits, run from the panels to outlets as indicated on the drawings. Each set of three or less ungrounded conductors in the same conduit enclosure shall have a neutral conductor, which shall be sized for not less than the unbalanced current of its associated ungrounded conductors and in no case less than the size of the associated power conductor.
- R. Appliance and Equipment Connections:  
Provide PVC insulated flexible cord sets for all cord and plug connected contract building appliances and equipment. Cords shall be sized in accordance with electrical circuits indicated on the drawings. Multiple conductor cords shall be type "SO" cable with PVC jacket and green insulated ground conductor.

**END OF SECTION**



## **SECTION 26-0522**

### **CONTROL WIRING**

#### **1.00 GENERAL**

##### **1.01 GENERAL CONDITIONS**

Control wiring is defined as that wiring which provides connections between control circuit elements and does not provide the power circuit into motor, heating or miscellaneous equipment terminals. Where a control device, such as push-button, thermostat, firestat, is to be installed in the branch circuit power lines, these devices shall be received, stored, and installed as indicated in the drawings and called for under the electrical specifications.

The items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### **2.00 PRODUCTS**

##### **2.01 MATERIAL**

As specified in other sections of the electrical specifications.

#### **3.00 EXECUTION**

- A. Control wiring and empty conduits for control wiring to be furnished only to the extent indicated on the electrical drawings.
- B. Control wiring required under other sections of this specifications shall be furnished and installed under that section unless specifically called for under this electrical section or indicated on the electrical drawings.
- C. Coordinate the installation of "in-line" (branch circuit power line) control devices with requirements in other sections of the specifications.

**END OF SECTION**



## SECTION 26-0526

### GROUNDING

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. The electrical system shall be complete with a grounding system; see Section 250 of the NEC. The grounding system shall be installed with electrical equipment and enclosures operating at ground potential and shall provide a low impedance path for ground fault currents. Ground system shall provide a resistance to ground not to exceed 25 ohms, as measured by the fall of potential methods. Grounding conductor shall be color coded per NEC.

- B. Electrical system and equipment grounds shall comply with local, state and NEC regulations.

Panel, conduit systems, motor frames, lighting fixtures, interior metallic water lines, other systems or equipment that are part of this installation shall be securely bonded both mechanically and electrically in accordance with all codes.

The items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Grounding conductors shall be insulated copper conductors as specified in "CONDUCTOR."
- B. Bare copper conductors used for a concrete encased ground electrode shall be 98 percent conductive soft drawn copper.
- C. Driven ground rods shall be copper-clad steel not less than 3/4 inch in diameter, 10 feet long, driven full length into the earth. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods as needed shall be installed not less than 6 feet on centers, or if sectional-type rods are used, two additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Architect shall be notified immediately in writing. Resistance shall be measured in accordance with IEEE Standard 142.
- D. Where required by drawings or by NEC, ground bushings shall be OZ type BLG or equal.

#### 3.00 EXECUTION

##### GROUNDING ELECTRODE SYSTEM

- A. When a metal underground water pipe is in direct contact with the earth of 10 or more feet and is electrically continuous, use the following as the system ground. Provide a continuous insulated copper grounding electrode conductor in a non-metallic conduit between the main service equipment ground bus and the entry point of the metallic water service pipe. Size grounding electrode conductor according to the electrical code. Make connection to water pipe in an accessible location with an Underwriters' listed pressure connection ground clamp or lug OZ type ABG.
- B. In addition to the water service ground, provide a concrete encased System Ground Electrode. Install at least 20 feet of bare copper conductor, (sized per drawings and table 250-66 of NEC), within and 2 inches from the bottom of a concrete foundation footing that is in direct contact with the earth. The "UFER" ground electrode conductor shall be run continuous to the Main Service Equipment Ground Bus. This ground conductor shall be installed in a non-metallic rigid conduit.

- C. In addition to A and B above, the metal frame of the building shall be used as a part of the Grounding Electrode System as required by the National Electrical Code.
- D. Except in locations indicated on drawings, the metallic conduit system (rigid or electrical metallic tubing) shall be used as permitted by the electrical code for equipment and enclosure ground system. Provide, as defined by the electrical code, grounding lugs, straps and green insulated copper grounding conductors each utilized and sized according to the electrical code.
- E. In locations indicated on drawings, an insulated grounding conductor shall be installed through the conduit system to the grounding terminal of each receptacle and bonded to the metal housing of each wall mounted or suspended light fixture.
- F. Install insulated bonding jumper between the grounded outlet and the grounding terminal of each receptacle. Install insulated bonding jumper between the grounded outlet and the metal housing of wall mounted lighting fixtures. Install insulated bonding wire in flexible conduit over 6 feet in length, in liquid-tite flexible conduit above 1-1/4 inches in diameter, and in non-jacketed flexible conduit in which the circuit conductors contained therein are protected by overcurrent devices rated more than 20 amps.
- G. Bond all equipment to the electrical system as required by the National Electrical Code.
- H. Prior to energizing system, the Neutral Disconnect Link (at the main service), shall be removed and the system neutral megged for accidental grounds. If system is accidentally grounded, necessary steps shall be taken to correct. After testing and neutral is found to be ungrounded, replace the Neutral Disconnect to main service equipment ground bus. A record of this test shall be given to the Architect.
- I. Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc., for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and brace bus bar in switchboards, or a separately mounted bar adequately braced or bolted to the enclosure of other types of equipment. the ground bar shall extend the full length of switchboards and motor control centers.  
  
The ground bar shall be adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact.  
  
Provide solderless pressure connectors for all conductor terminations. Number equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.
- J. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated, the coating must be removed down to the bare metal. After the coating has been removed, apply a non-corrosive approved compound to cleaned surface and install lugs and clamps. Where galvanized is removed from metal, it shall be painted or touched up with "Galvanox" or equal.
- K. Test the completed grounding system with a meggar at the service ground bar and submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect.
- L. Where a grounding conductor is installed in conduit, the grounding conductor shall be physically bonded to the metal conduit and/or box system every 100 feet or fraction thereof.

**END OF SECTION**

## SECTION 26-0530

### EXCAVATION, BACKFILL & CONCRETE ENCASEMENT

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

All excavation shall be in accordance with the Occupational Safety and Health Act of 1970 (PL91596)

##### 2.00 PRODUCTS

##### 2.01 MATERIAL

This section is not applicable.

##### 3.00 EXECUTION

- A. Width and depth of all trenches are to be as indicted on Drawings or noted in Specifications.  
All bracing and shoring shall be included when depth and soil conditions require their use.
- B. Backfill underlying existing or new pavement shall be compacted to 95% of the maximum dry density of the surrounding soil. Selected backfill material shall consist of finely selected earth, stone dust, and/or other approved material, carefully placed in uniform 6" layers to a depth of at least 18" above the conduit. Each layer shall be thoroughly compacted with proper hand or power tools. If suitable select materials are not available from trench excavation, the Contractor will be required to obtain them elsewhere at his own expense.

After selected backfill material has been placed and tamped, the remainder of the trench may be back filled with general excavated material, provided such material shall not contain more than 1/3 broken rock, of which no single stone or boulder shall weigh more than 50 pounds. Backfill materials shall be placed in uniform layers thoroughly compacted with heavy duty power tamping tools or the "Wacker" type, to the full satisfaction of the Architect.

The contractor may with the approval of the Architect backfill conduit trenches with a spec slurry mix in place of above mentioned select material.

When the trenches have not been properly filled or settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Back filling shall be carefully performed and the original surface restored to the full satisfaction of the Architect. Surplus material shall be disposed of off-site or as directed by the Architect.

- C. Excavation of trenches and pits shall include all excavation of every description and whatever substance encountered, disposal of excess material shall be required on completion of work.
- D. Excavation of all trenches shall be by open cut. The top portion of the trench may be excavated with vertical or sloping sides to any width within the construction easement which will not cause unnecessary damage to adjoining structures, roadways, pavements, utilities, trees, or private property. Minimum depth of all underground conduit shall be 24" below final grade unless otherwise noted.
- E. When concrete encasement is required, it shall be so indicated on the drawings. The contractor shall use 1500psi concrete with a red oxide color additive. The additive shall be mixed in with the concrete while in the truck or poured uniformly over concrete once poured
- F. Excavation for manholes shall extend a minimum of 12" below the planned elevation of the base of the manhole. The bed shall then be brought to proper grade with compacted crushed stone or gravel. Stone or gravel bedding materials shall consist of crushed stone or gravel, 3/4" and less in size. Bedding material shall be placed on a flat bottom trench and thoroughly compacted by

tamping or slicing with a flat blade shovel. Balance of backfill for manholes shall be the same as indicated above.

- G. The contractor shall bury a YELLOW warning tape approximately 12" above all buried conduits that are outside the perimeter of the building.
- H. The contractor shall provide the owner with asbuilts of all buried electrical conduits with dimensions from permanent buildings and structures to indicate exactly where the conduit is buried.

**END OF SECTION**

## **SECTION 26-0533**

### **ELECTRICAL IDENTIFICATION**

#### **1.00 GENERAL**

##### **1.01 GENERAL CONDITIONS**

Major items of electrical equipment and major components shall be permanently marked with an identification nameplate to identify the equipment by type or function and specific unit number if shown on the drawing. The items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### **2.00 PRODUCTS**

##### **2.01 MATERIAL**

- A. Labels shall be provided on outside face of safety switches, panelboards, motor starters, controls, and contractors. Labels shall be laminated black and white phenolic type with 1/4" letters engraved through black to white, and red to white for emergency. Label to indicate voltage, number of phases, circuit number and device or unit it operates.
- B. Lighting and appliance panelboards shall also be labeled internally as designed on the drawings.

#### **3.00 EXECUTION**

Label attached to inside of covers shall be mounted with adhesives while labels on the outside shall be mounted with two #6-32 x 1.4 inch self tapping brass round head screws unless this will damage the integrity of the enclosure. If this occurs, a location on the inside or outside can be used. The use of brass screws shall be used if possible for attachment.

**END OF SECTION**



## SECTION 26-0534

### RACEWAYS/CONDUIT

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. Where the word "Conduit" is used in these Specifications, it shall mean either rigid metal or rigid non-metallic conduit as set forth hereafter.
- B. Where the words "flexible conduit" are used, it shall mean either jacketed liquid-tite or unjacketed flexible metal conduit as set forth hereafter.

Minimum size of any raceway shall be 1/2" unless otherwise noted differently on the drawings.

Items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 MATERIALS

- A. Flexible metal conduit (FMC) shall be a minimum length of 8" and at least six times the trade diameter for conduits 1-1/2 inches or larger.
- B. Flexible conduit for connections to lighting fixtures shall be minimum 3/8" diameter and a minimum of 36" and a maximum 72" in length, and shall be non-jacketed with a continuous strip cold rolled galvanized steel core. Liquid-tite flexible metal conduit (LFMC) shall be a minimum 1/2" diameter jacket over a continuous strip cold rolled galvanized steel core.
- C. Connectors for flexible conduit shall be UL Listed with insulated throats. Connectors for liquid-tite flexible conduit shall be compression type, made of steel and provided with O-ring. Connector's metal ferrule shall be squeeze-type and made of malleable iron. Connectors shall be manufactured by Appleton, Thomas & Betts, OZ/Gedney or equal.
- D. Non-metallic rigid conduit (NMRC) shall be Schedule 40, 90 Degree C rated polyvinyl chloride, UL Listed for underground direct burial, unless otherwise noted. Abbreviated as PVC.
- E. All fittings used with NMRC shall be manufactured, approved and intended for use with each conduit type and installed in its intended manner.
- F. Fittings for rigid steel conduit shall be threaded type only. Plastic or metallic bushings may be used on branch circuits, while OZ type "B" or equal metal bushings with high impact Thermoset Phenolic Insulation inset shall be used on all feeder circuits and conduits larger than 2" in diameter.

Fittings for Electrical Metallic Tubing (EMT) shall be (\*\*) compression/set screw type only. Connectors shall have insulated throats. Where 2" and larger connectors are used, metal bushings with OZ type "B" bushing shall be used. All fittings shall be of the (\*\*) Malleable or Steel quality. Set Screw fittings for 2-1/2" and larger conduit is acceptable.

- G. Conduit fittings shall be listed and intended for use within the area it is installed and for conduit type it is used with. RMC fittings shall be of the same material as the conduit it is to be used with. Dissimilar metals shall not be used.

#### 3.00 EXECUTION

##### 3.01 CONDUIT INSTALLATION

- A. PVC Schedule 40 Conduit shall be installed where direct buried in earth, concrete encased in earth, or under the slab on grade. It shall not be installed on the interior of the building.
- B. EMT shall be installed only within the building, where exposed and not subject to physical damage, concealed or in concrete slabs which are not in contact with earth. When installed in concrete, concrete tight fittings shall be used. (\*\*) When installed in concrete slabs, provide a separate insulated ground wire sized per code even if not shown on the drawings. If the local jurisdiction requires that EMT be coated with a corrosion protective material when installed in concrete slabs above grade, the contractor shall so provide.
- C. Provide sealtite flexible conduit and connectors to rotating or vibrating machinery and equipment, dry transformers, heating units, cooking equipment and where indicated on the drawings.
- D. Provide unjacketed flexible conduit and connectors to lighting fixtures in lift out ceilings to an outlet box located above the ceiling.
- E. In damp locations use only GRS conduit and along with all equipment, install with a 1/4" air space between wall and equipment.
- F. For slab on grade construction, horizontal runs of GRS conduit can be installed below or in the floor slab.
- G. Except where otherwise indicated, conduits installed in concrete floor slabs shall be GRS conduit with threaded couplings. GRS conduit shall be used for all runs where subject to mechanical damage.
- H. Install exposed conduit systems parallel to or at right angles to the lines of the building. Right angle bends in exposed conduits shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii not less than those of standard elbows. Where conduit is exposed and below 6 feet above the finished floor and subject to physical damage it shall be GRS conduit.
- I. All conduit systems shall be concealed unless otherwise noted or indicated. Conduit systems may be exposed in unfinished utility areas, ceiling cavities, and where specifically approved by the Architect. Install concealed conduit systems in as direct lines as possible
- J. Conduits shall be installed a minimum of 12" in free air from any hot water or steam lines and a minimum of 3" in free air from other mechanical lines. Conduit shall be thoroughly clean and dry inside prior to installation of conductors.
- K. When PVC Schedule 40 conduit is installed underground, it shall terminate below grade or floor slab and continue above grade with GRS conduit, unless otherwise specified on the drawings.
- L. Conduits installed underground outside building foundations shall be a minimum of 24" below finished grade and where indicated on the drawings shall be encased in 1500 psi concrete envelope with 3" of coverage.
- M. All GRS conduit that is in direct contact with earth shall be 1/2 wrapped with (or equal to) 3M "Scotchwrap" #50 PVC 10mil tape, or shall have an additional outside factory coating of PVC with a minimum coat thickness of 20 mils. Other PVC or phenolic-resin-epoxy coating material which is equally flexible and chemically resistant may be used providing approval by the Architect is obtained prior to installation.
- N. Prevent lodgement of plaster, dirt or trash in conduits, boxes and fittings. Seal conduits with plastic or metal caps and fittings. Store conduit in racks above ground. All raceways shall be swabbed out before any wires are pulled and wires are not to be installed until building construction has progressed to a point that no moisture would enter the raceway.
- O. Conduit ends shall be cut square, threaded and reamed to remove burrs cutting edges. Conduit joints shall be made with standard conduit couplings, no running threads permitted. Paint conduit threads with "LPS Zinc Rich" where conduits are installed below grade or where threads are non-galvanized.

- P. All conduits that pass through a rated firewall or floor shall use an approved fire stop even if not shown on the drawings or called for in these Specifications.
- Q. All conduit lines left empty for future use and for telephone conductors shall have a conduit measuring tape of 200 pound tensile strength or equal pulled into the conduit and tied off at each end.
- R. In any conduit run, the number of quarter bends or equivalent between terminations at cabinets, pull boxes, outlet boxes or condulets shall not exceed four bends for conduits up to 1-1/4", three bends for 1-1/2" to 2-1/2" and two bends for larger conduits. Conduit runs between cabinets, fittings or boxes shall not exceed 200' for straight runs nor 100' for runs with maximum number of bends. Conduit bends and offsets shall be made with conduit hickey or conduit bending machines. Crushed or deformed conduits shall not be installed.
- S. Conduits shall be grounded as provided by the NEC and these Specifications.
- T. Where the project has a floating slab, the contractor shall include all expansion joints for conduits that are underground and routed up and into the building space through the floor slab. The expansion joints shall be mounted in the floor slab so the conduits can move up and down with the movement of the floor slab. The contractor shall also take into account all of the conduits entering and leaving any electrical equipment that is attached to the floating slab such that the conduits are flexed connected to the equipment again to allow for movement of the floor slab.

### **3.02 CONDUIT TERMINATIONS & FITTINGS**

- A. Conduit entering outlet boxes, junction boxes, cabinets, or electrical equipment not having threaded hubs shall be fitted with galvanized locknuts and bushings inside and out. Sufficient conduit thread shall extend into the enclosures or fittings for installation of locknuts and bushing such that end of the conduit shall butt tightly with end of the bushing. In wet, damp or in concrete locations, conduit joints shall be made water-tight by applying a coating of approved pipe dope in conduit thread area prior to assembly and use of approved water tight connectors, and fittings.
- B. Install sealing fittings where required by the NEC, where conduits pass from warm to cold locations, or hazardous to non-hazardous areas. The contractor shall not pour seal-off fittings until directed by the Architect. It is expected that this work will be performed after completion of the initial contract installation.
- C. Each conduit that is buried in, or rigidly secured to the building's construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings shall be hot-dipped galvanized malleable iron with factory installed packing and a ground ring.

### **3.03 CONDUIT SUPPORTS**

- A. Provide supports for horizontal conduits not more than 8 feet apart with one support near each elbow or bend, including runs above suspended ceiling.
- B. Install conduit clamps or malleable or steel galvanized iron straps. Perforated strap iron and/or wire is not acceptable. Install individual pipe hangers for conduits. Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.
- C. Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. All fastenings to the building structure shall be made with clamps or suitable adhesives. Building structural steel shall not be welded, drilled, burned without the approval of the Architect.
- D. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy Fasteners or ERICO Products, Inc. Wire wrapped around conduits and supporting members will not be acceptable.

- E. Conduits run above ceiling shall be supported to the building structure, independent of ceiling system support.

#### **3.04 CLOSING OF OPENINGS**

Whenever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceways, including bus ducts, such opening, if unused, or the spaces left in such opening, shall be filled or closed with firestops material in a manner approved by the Architect.

#### **3.05 IDENTIFICATION**

Identify all raceways according to the circuits and/or the system carried. Identify by labeling inside of all equipment enclosures, cabinets, pull boxes or outlet boxes where conduit is terminated by means of marking pen written on the inside of the sheet metal box next to the conduit penetration. The circuit label for outlet boxes with blank covers shall be on the outside surface of the cover. Other means if different shall be indicated on the drawings.

**END OF SECTION**

## SECTION 26-0537

### BOXES & BOX FITTINGS

#### 1.00 GENERAL

##### 1.01 General Conditions:

- A. Provide all junction boxes, pull boxes and outlet boxes as indicated on the drawings or as specified.
- B. Each lighting fixture, receptacle, switch device, and signal device, etc., shall be provided with an outlet box. Boxes shall be of sufficient size for the number of conductors in the box per N.E.C.
- C. The items under this section of the specifications do not have to be submitted for approval and/or include in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 Material:

- A. Pressed steel galvanized outlet boxes and box fittings shall be manufactured by Raco, Bowers, Steel City or T&B.
- B. Outlet boxes shall be a minimum of 1-1/2" deep x 4" x 4" square or octagonal when used with fixtures unless a larger size is required by the device being installed.
- C. Outlet boxes for use in masonry-block or tile walls shall be square-cornered tile type, or standard boxes with square-cornered tile type covers.
- D. Outlet boxes for use in concrete shall be concrete approved type.
- E. Junction boxes and pull boxes shall be painted sheet steel with lapped and welded joints, 3/4" flange, and removable screw cover for use in dry locations, and have weatherproof hinged or screw covers for use in wet locations. Size, type and NEMA 1 rating shall be indicated on the drawings. Unless otherwise noted, they shall be NEMA 1 with a screw cover.
- F. Cast outlet boxes shall be as manufactured by Appleton, Crouse Hinds or OZ/Gedney. Size and type shall be indicated on the drawings.
- G. Cast outlet boxes for metallic raceways shall be of the cast-metal hub with a gasket and cover when located in normally wet locations, (or indicated on the drawings), including when surface mounted on exterior surfaces.

#### 3.00 EXECUTION

- A. Each box shall have the volume required by the NEC for the number of conductors enclosed in the box.
- B. Where exposed or concealed wiring is indicated, provide a surface or flush mounted galvanized pressed steel outlet box complete with raised device cover as indicated.
- C. Outlet boxes for mounting lighting fixtures shall be installed as required by the fixture configuration. Separate metallic boxes shall be provided for flush or recessed fixtures. When required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the box unless ceiling access panels are provided.
- D. Outlet boxes shall be provided in the wiring system wherever required for pulling of wires, making connections, making transitions from one wiring method to another, and mounting of wiring devices, signal devices or lighting fixtures. At the discretion of the Architect, any outlet may be relocated up to ten feet without incurring any additional cost. Relocation must be made prior to roughin. All outlets occurring in wall panels or in other architectural features shall be centered. Mounting height dimensions called for refer to the finished floor level if inside and grade level if

outside. Outlet boxes for receptacles and telephones shall be arranged such that the cover plates will be installed vertically with the floor. On exposed tile, block, or brick construction, mount outlet boxes at the nearest bond joint to the mounting height indicated. Coordinate with the architectural drawings for the exact location of all outlets in, below or above any and all cabinets.

- E. Outlet boxes and pendants for surface mounted fixtures on suspended ceilings shall be supported independently of the ceiling supports, or supported with bar hangers designed for the purpose.
- F. Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by powered charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of wood screws, expansion shields or machine screws.

Junction boxes, pull boxes and outlet boxes shall be installed so that the wiring contained in the box may be rendered accessible without removing any part of the building structure.

Provide a grounding terminal in each box containing a green equipment ground conductor, or serving motors, or receptacles. Grounding terminal shall be green-colored washer-in-head machine screw or grounding bushing.

Identify all outlet, junction and pull boxes according to the system carried by means of painted stencils or labels, with legible letters and contrasting colors and without abbreviations.

All exterior flush mounted in the wall boxes shall be caulked and watersealed to prevent water and air passage into the building. This includes all boxes for receptacles and light fixtures. If a box is surface mounted on a wall and has a conduit penetration into the building, this hole shall be watersealed.

**END OF SECTION**

## SECTION 26-2413

### SWITCHBOARDS

#### 1.00 GENERAL

##### 1.01 Material:

- A. Switchboards shall have voltage and ampere capacities as indicated on the drawings, and shall bear Underwriters' labels.
- B. Contractor to provide full shop drawings for review and approval and also include this system in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 Material:

- A. Switchboard shall be free standing, nema 3r, floor mounted, and nominal ninety (90) inches high, and shall be constructed with code-gage steel structure, reinforced bolted corners, and enclosed with code-gage removable steel covers. Bussbars shall be mounted on high impact, non-tracking insulators. Covers shall be cleaned or phosphatized before applying an acrylic lacquer or baked enamel finish.
- B. Provide circuit protective devices and instruments as indicated on the drawings and provide engraved laminated nameplates for all devices. All devices shall be fully rated, a minimum of 100,000 amperes symmetrical interrupting, unless otherwise noted on the drawings.
- C. Provide ground bus through the full length of switchboards.
- D. Provide means of jacking and lifting switchboards as to prevent any damage to structural members of the equipment. Provide required shipping splits.
- E. Connection hardware shall be of non-corrosive material or cadmium plated.
- F. Bussbars shall be copper braced for the symmetrical short circuit current as indicated in Section 2.01-B above. All live buses shall be phase-isolated in the rear of the section. The vertical buses shall be isolated and insulated from the main buses with full length glass polyester barriers. The main buses shall be phase-isolated and insulated from each other and from the device load lugs by means of isolating insulating barriers. Bus joint bolts shall be insulated with removable caps to allow maintenance without the removal of barriers. Aluminium silver plated bussing is acceptable in lieu of copper bussing.
- G. The Utility Pull Section, Metering Section and all equipment for use by the Power Company shall meet all local utility requirements.
- H. Applicable standards: NEMA standards publication #PB2-1975 and Underwriters' Laboratories Standard #VL891.
- I. Switchboard manufacturers: General Electric, Square D, Seimens / ITE, Cutler Hammer and Westinghouse only. No others are acceptable unless approval is obtained from the engineers prior to the bidding of this project.

#### 3.00 EXECUTION

- A. When indicated on drawings, install switchboard on 4 inch concrete pad. Secure to pad with 1/2 inch threaded bolts and nuts. Switchboard shall be completely level after installation.
- B. Prior to the utility connection to the switchboard, the Contractor shall meggar all three phases of the bus to ascertain there are no shorts or grounds on the equipment bussbars. These shall be recorded.
- C. Prior to energizing switchboards, clean and/or vacuum enclosure of all foreign matter. Clean cement, plaster, paint and other drippings from bussbars and connection points. Avoid damage to bussbar plating while removing foreign matter. If plating is damaged, apply joint compound over damaged area.

- D. At the time of project completion and acceptance, switchboards shall be given a complete maintenance check-up.

Check-up shall include removing end shields and tightening all bolted connections on frame and bussbars, touch-up all scratches with spray paint of the same color as the switchboard, and inspect all cable connections.

**END OF SECTION**

## SECTION 262416

### PANELBOARDS

#### 1.00 GENERAL

##### 1.01 General Conditions:

Panelboards shall have voltage and ampere capacities as indicated on the drawings, and shall bear Underwriters' labels. Contractor to provide full shop drawings for review and approval and also include this system in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 Material:

- A. Panelboards boxes shall be a minimum of 20" wide (U.O.N.) and provided with surface or flush trims with doors as indicated on the drawings. Provide locks on trims with all locks set to the same two keys furnished per lock. All panels keyed alike.
- B. All panelboards shall have door in door type front panel construction with nameplate as indicated mounted on front of panel.
- C. Furnish typewritten directory boards to identify each circuit. Note spare circuits on directory cards in pencil.
- D. (\*\*) Bussbars shall be copper and arranged for bolt-on circuit or plug-in breakers or square D "I" line circuit breakers as indicated on drawings. Sequence phase bussbars so that two consecutive circuits are not connected to the same phase. Provide main breakers and lugs to accommodate feeders as shown on "Riser Diagram". Neutral block shall be isolated from panel and ground. Aluminium silver plated bussing is acceptable in lieu of copper bussing.

Circuit breakers shall be thermal magnetic molded case single pole and multi-pole with common trip. Interrupting ratings are RMS symmetrical values. Circuit breakers shall have interrupting capacities of at least 10,000 amperes for all 120/208 volt panels. Circuit breakers with greater interrupting capacities shall be as scheduled on the drawings. Type of circuit breaker shall be indicated on the drawings.

Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle but for sizes of 100 amperes or less may consist of single-pole circuit breakers permanently assembled at the factory into a multi pole unit having an internal mechanical, non-tamperable common trip mechanism and external handle ties.

- E. Circuit breaker and switches used for motor-circuit disconnects and not in sight from the motor controller, shall be capable of being locked in the open position.
- F. Wiring gutter for panelboards shall be in accordance with the National Electric Code. Nameplates shall be as approved.
- G. Circuit breakers used to control H.I.D. lighting shall be rated as such.
- H. Circuit breakers used as a switching device and so indicated on drawings shall be marked from the manufacturer as being suitable for use as a switch.
- I. All circuit breakers over 100A shall be stamped and rated at 70 degree C.
- J. Applicable standards: NEMA standards publication PB-1, UL-67.
- K. Where the drawings indicate that a panel and / or panels are fed with oversized neutral conductors, the respective panel(s) shall be furnished with neutral busses that are rated at 200% of the line bussing and shall contain oversized lugs on the neutral bussing to accept the oversized

neutral conductors. In lieu of providing the oversized neutral bussing as indicated above, the contractor may provide normal panels with all bussing oversized and with neutral lugs large enough to accept the oversized neutral conductors.

- L. Panelboard manufacturers: General Electric, Square D, Westinghouse, Seimens / ITE, Challenger only. No others are acceptable UNLESS APPROVAL IS OBTAIN FROM THE ENGINEER PRIOR TO THE BID.

### **3.00 EXECUTION**

- A. Prior to energizing panelboards, clean out construction dirt and debris. Panel interiors shall be dusted and scratches on fronts and barriers painted.
- B. All critical branch panelboards including isolated power panels in anesthetizing locations shall be furnished with grounding bushings on all conduit terminations at the panelboard, with grounding bushings connected to panelboard ground bus by means of a continuous sized insulated conductor. Panels feeding data processing equipment and for circuits requiring isolated circuits and grounds shall have a ground bar insulated from the panel box by use of stand-off barrel insulators.
- C. Install panel boxes plumb and true and at mounting heights that locate the top of the panel at 6'6".
- D. Adjust inside panel barriers so that no openings occur between them and the panel fronts.
- E. Contractor shall review all electrical, mechanical, plumbing, and architectural drawings prior to rough in of any, and all panels and transformers to ensure that the location as shown is acceptable per all codes and the panel will not be interfered with during the construction of the project. If there are interference problems, coordinate with other trades to eliminate or contact architect and, or engineer to correct equipment location. The contractor shall also ensure that if the panels are flush mounted in a wall that the walls have the proper thickness and if not shall so inform the architect prior to roughin of the wall.

**END OF SECTION**

## SECTION 26-2717

### EQUIPMENT WIRING

#### 1.00 GENERAL

##### 1.01 MATERIAL

- A. All motors except where specified herein, shall be furnished under other sections of the specifications. Confirm all motor locations.
- B. Motors shall be of the voltage and phase characteristics as shown on the drawings.
- C. The horsepower ratings indicated are for guidance and do not limit the equipment size. When electrically driven equipment furnished under other sections of these specifications differs from the contemplated design, the Contractor shall be responsible for the necessary adjustments to the conduit, wiring, disconnect devices, and branch circuit protection to accommodate the equipment installed.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Single or double pole manual motor starter (with overloads) switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80% of the switch rating.
- B. Automatic-control devices such as thermostats, float or pressure switches and Manual-Off - Automatic switches may control the start and stopping of motors directly provided the devices used are designed for that purpose and have an adequate HP rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used with the automatic control device actuating the pilot-control circuit. All safety control devices, such as low or high pressure cutouts, high temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit.
- C. Motor controllers shown on the drawings adjacent to motors are for reference only. They shall be wall-mounted not more than six feet above the floor or mounted on the equipment if readily accessible from the floor. The control voltage of magnetic starters shall not exceed 120 volts. The overload-protective device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure; however, all overload devices shall be located and be accessible as specified above for controllers. Unless otherwise specified, the protective device shall be of the manually reset type.

#### 3.00 EXECUTION

- A. Furnish and install power wiring to motors and mechanical equipment. Wiring into motor or equipment terminals shall be complete with connections through associated disconnect switches, and motor starters, including "in-line" (branch circuit power line) controlling devices.
- B. Receive, store, and install individually mounted starters and controllers for motors.
- C. Wiring shall be in conduit, with final connection to rotating equipment made through a section of PVC jacketed flexible conduit.
- D. Multi-speed and reduced voltage start motors shall be connected as recommended by equipment manufacturer.
- E. Motors shall be grounded as specified under "Grounding System".
- F. Contractor shall check all motors before start-up for correct phase and voltage on motor nameplate information and insure proper sizing. Correct where necessary.

- G. Contractor shall test all motors for correct shaft rotation and smooth operation during start-up and immediately after start-up. Where rotation is in the wrong direction, the contractor shall correct.
- H. Motor windings shall be subjected to an insulation resistance test.
- I. A load test shall be conducted by the Contractor on motors and the current readings taken, recorded and checked against nameplate rating. If current reading exceeds nameplate rating, Contractor shall notify the Architect.
- J. Each motor controller and/or disconnect switch hereinafter specified shall be clearly labeled on the cover to indicate the equipment controlled.
- K. Chandelier Lift: Use remote mount kit, coordinate with owner and structural Engineer.

**END OF SECTION**

## SECTION 26-2726

### WIRING DEVICES & PLATES

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. Switches and receptacles shall be furnished and installed as called for on the drawings and/or specified herein.
- B. Device plates shall be provided for all devices and boxes and be suitable for the device or devices installed.
- C. Contractor to provide full shop drawings for review and also include this system in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Wall switches shall be of totally enclosed toggle type with bodies of phenolic, melamine, or urea resin compounds. Handles shall be ivory Color Per Drawings. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20 ampere, 120/277 volt for use on AC systems only. Switch devices shall be premium specification grade and shall be manufactured by Hubbell, Arrow-Hart, Bryant, Pass & Seymour, GE, Sierra or equal.
- B. Single and duplex receptacles shall be rated 20 ampere, 120 volts, two-pole, three-wire, grounded type with polarized parallel slots. Bodies shall be ivory in Color. phenolic melamine or urea resin compounds supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side-or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Receptacles with ground fault interrupters shall be in accordance with UL 943. Class and current rating shall be as indicated on the drawings. Receptacles shall be premium specifications grade and shall be manufactured by Arrow-Hart, Hubbell, Pass & Seymour, Sierra, GE, Bryant or equal.
- C. Weatherproof receptacles shall consist of a duplex receptacle as specified above in a cast metal box (if exposed) and with a gasketed, weatherproof, metal cover plate and a separate cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a short length of bead chain or shall be provided with a spring hinged flap. Weatherproof receptacles shall be rated at 20 ampere, 120 volts.
- D. Special purpose or heavy duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle type plug shall be furnished with each receptacle. Locking facilities, where indicated, shall be accomplished by the rotation of the plug.
- E. Device plates of the one-piece type shall be provided for all outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast metal (ferro magnetic) on iron alloy boxes and fittings. All plates shall have either rounded or beveled edges as required. Plates on finished walls shall be high-impact thermoplastic, specification grade, white in color, plastic with beveled edges. Screws for plates on finished walls shall be of metal with counter-sunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices, jumbo plates may be used. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16". The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed.

### 3.0 EXECUTION

- A. Where more than one switch and/or receptacle is indicated in the same location, switches shall be mounted in multi-gang box under a common device plate.
- B. Attach switches with screws to the associated outlet box, without depending on the device plate to pull them tight. The cover plates screws shall have the slots pointing north and south.
- C. Mounting heights shall be as follows unless otherwise noted on the drawings.
- D. Where receptacles are indicated for mounting over a counter, coordinate exact mounting height with elevations included in architectural drawings or in project shop drawings. Contractor shall review all architectural drawings to determine all location and mounting heights prior to any roughin.
- E. Install a green insulated bonding jumper between receptacles and grounded outlet boxes.
- F. Each outlet that is for use as a junction box, or for future device or fixture, shall be fitted with a blank device plate to match other device plates.
- G. Floor outlets for power and telephone shall be as indicated and specified in the electrical symbols or legend notes on the drawings.
- H. Receptacles in walls installed back-to-back will be allowed only in Mechanical spaces, storage rooms and other areas where sound transmission from room to room is not objectionable. In all other areas receptacles shall be installed in separate boxes connected with a piece of conduit
- I. Contractor to make certain that no devices are mounted in a direct back to back fashion in common walls that will allow for sound transmission from one room to another. Provide a minimum of 12 inches of horizontal spacing between devices that are shown mounted in similar locations on opposite sides of the wall in order to maintain the required sound attenuation of the walls.
- J. All dimmer switches that are furnished and installed by the contractor shall be rated at a minimum of 125% of the full connected load that the dimmer is to control.

**END OF SECTION**

## SECTION 26-2813

### FUSES

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

Each fusible disconnect shall be provided with working fuses sizes and types as indicated. Contractor to provide full shop drawings for review and approval. These items do not have to appear in the O & M Manuals.

##### 2.00 PRODUCTS

- A. Fuses in switchboard and main distribution panelboards shall be Bussmann "Low Peak" or "Hi Cap". All other fuses shall be dual element "Fusetrons" or "Low Peak" if not so indicated on drawings. All fuses shall have rejection feature (Class R).
- B. Motor fuses shall be sized as listed on the motor nameplate unless otherwise noted. Provide label in each switch stating size and type of fuse.
- C. Replace all opened fuses up to final acceptance of job.
- D. The contractor shall furnish and install a spare fuse cabinet and mount in a location with acceptable space and per the architect. Where possible, it shall be placed in the main electric room. The contractor shall determine the actual size of the cabinet based on the physical size of all spare fuses. On the Spare Fuse Cabinet the following nameplate shall be placed on the front cover:

**"WARNING, REPLACE ONLY WITH CURRENT LIMITING FUSES AS ORIGINALLY INSTALLED"**

##### 3.00 EXECUTION

- A. The contractor shall furnish a complete set of fuses for all switches, panels, bus plugs, switchgear, and motor control centers as required.
- B. Provide in a wall mounted metal cabinet in the electric room a spare set of fuses used in switchboard, panelboards and elsewhere on project. Quantities shall be 10% of total or minimum of 3 fuses for each size and type. Cabinet shall be labeled "Spare Fuse Cabinet."
- C. Fuse manufacturers shall be Bussmann. All fuses on the project shall be of the same manufacturer.

**END OF SECTION**



## SECTION 26-2818

### ENCLOSED SWITCHES

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

Each motor or piece of equipment so indicated on the drawings shall be provided with a disconnecting means under this section of the specifications when required by the N.E.C. even though not indicated on the drawings. Contractor to provide full shop drawings for review and approval. These items do not have to appear in the O & M Manuals.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Disconnect switches shall be quick-make, quick break, UL labeled, Heavy Duty safety switch. Switch ratings shall be for the applied voltage and current. Disconnects shall be non-fused type except where noted otherwise on drawings or if fused type is required by manufacturer's nameplate on equipment served (in which case fuses shall be sized as recommended by manufacturer). Where fusible safety switches are specified, they shall contain Class R fuse rejection clips unless otherwise indicated.
- B. Disconnect Switch enclosures shall be:
  - 1. For indoor - NEMA 1 general purpose
  - 2. For outdoor - NEMA 3R raintight
- C. Designate with permanent labels, the maximum allowable fusing capacity and fuse type for fusible switches. Install label on inside cover.
- D. Disconnects for 120 volt motors 1/2 HP or less, may be motor rated thermally protected toggle switches in steel outlet boxes. SQ D Class 2510 or equal. Heater to be rated 115% of actual motor full load current.
- E. When a disconnect switch is used with motors or heating units, it shall be an approved HP rated type.
- F. When a disconnect is used as service equipment it shall be rated for use as "Service Entrance Equipment".
- G. Manufacturers shall be General Electric, Westinghouse, ITE, Square D.

#### 3.00 EXECUTION

Each disconnect shall be located in sight from the motor location. The disconnecting means shall be capable of being locked in the open position when the motor is not in sight of the switch and controller unless another disconnecting means is located at the motor.

END OF SECTION



## SECTION 26-5100

### LIGHTING FIXTURES AND LAMPS

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. Lighting fixtures shall be as indicated on the "Project Luminaire Schedule" on the drawings, and shall have a UL label and conform with NEC and local code requirements.
- B. Provide new lamp(s) with each lighting fixture. Lamp types and quantities for each fixture are specified with the fixture type description in the "Project Luminaire Schedule".
- C. Provide ballast for each ballasted lighting fixture with the type, wattage and voltage as specified with the fixture type description in the "Project Luminaire Schedule".
- D. Before ordering light fixtures, the contractor shall verify that all fixtures are compatible with the ceiling and with the environment in which the fixture will be installed. Fixture housing and frame shall be arranged to match the ceilings called for on the Architectural drawings, and specified in other divisions of the specifications.
- E. Submit shop drawings for review. Shop drawings shall include fixture cuts indicating project type designation, manufacturer, catalog number, lens dimensions, photometrics, voltage and type of lamp for each fixture proposed for use. Also include this system in the O & M Manuals
- F. If the contractor submits site lighting fixtures that are different than those that are specified, they must submit a full site photometric layout with the fixtures for approval. If this layout is not submitted, the site fixtures can be rejected.
- G. All dimmer switches that are furnished and installed by the contractor shall be rated at a minimum of 125% of the full connected load that the dimmer is to control.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Fixtures shall be as shown in the "Project Luminaire Schedule" on the drawings.
- B. Where flat acrylic lenses are specified for fluorescent fixtures, they shall be manufactured with 100% virgin acrylic and be a minimum thickness of 0.125 inches. Lens manufacturers: KSH, Carolite, Plaskolite.
- C. Incandescent lamps: Inside frosted, 120 volt series; par and reflector type lamps - 130 volt.
- D. Fluorescent lamps: Lamp color and type as indicated on the contract drawing
- E. Metal halide and high pressure sodium: Lamp color and type as indicated on the contract drawings.
- F. Mercury vapor lamps: Lamp color and type as indicated on the contract drawings.
- G. Lamp Manufacturers: General Electric, Westinghouse, Sylvania or Osram as indicated on the contract drawings.
- H. Ballasts shall have Underwriters' label.
- I. Fluorescent ballasts: High power factor, rapid start, CBM, Class-P labeled, electronic type that is rated equal to or less than 20% THD unless otherwise noted as equal to or less than 10% THD type on the construction project drawings. Where exposed to cold temperatures they shall be low temperature rated type.

All "PL" lamp ballast shall be of the high power factor type.

- J. Fluorescent ballast manufacturers: Osram / Sylvania, Advance or Magnetek
- K. Metal Halide Ballasts: For wattages of 150 or less the ballast shall be High Power Factor (greater than 95%) electronic (equal to or less than 10% THD) type manufactured by Aromat; for wattages of 175 watts or more the ballast shall be high power factor constant wattage auto transformer (CWA) type unless "pulse start" type is referenced specifically or indicated by the type of lamp specified.
- L. Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.
- M. Suspended Fixtures shall be provided with swivel hangers in order to insure a plumb installation. Pendants 4 feet or longer shall be braced to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers.

### **3.00 EXECUTION**

- A. Before ordering light fixtures, the contractor shall verify that such fixtures are compatible with the ceiling and with the environment in which the fixture will be installed. Fixture housing and frame shall be arranged to match the ceilings called for on the Architectural drawings, and specified in other divisions of the specifications.
- B. Install fixtures to center or replace acoustical tile sections. Support fixtures from the building structure through the use of the ceiling support system, where the ceiling support system is designed for the lighting fixture's weight. Fluorescent lighting fixtures installed in exposed ceiling grid ceilings shall be provided with two (2) "safety clips" or "safety hooks" for securing fixture to ceiling grid, and located at opposite corners of fixture.
- C. Fluorescent fixtures installed in exposed grid ceilings shall be provided with a #14 gauge galvanized safety hanger wire which shall attach the fixture to the building structural system to prevent the fixture from falling due to movements in ceiling suspension channels. This safety wire shall be attached to fixture at a point other than where safety clips are attached.
- D. Support surface lighting fixtures of more than ten pounds in weight with threaded rods from the building structure.
- E. Install plaster frames for lighting fixtures recessed in plastered ceilings.
- F. At the time of project completion and acceptance, all fixtures shall be clean and all diffusers free of breaks and defects.
- G. Lamps shall be new and burning at the time of project completion and acceptance.
- H. When fixtures are shown to be using ceiling slope adapters, the contractor shall include all necessary and required addition supports and / or bracing as required to install the fixture in a proper manner.

**END OF SECTION**

## SECTION 271005

### TELEPHONE DISTRIBUTION SYSTEM

#### 1.00 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. Provide a complete telephone distribution system as indicated on drawings and as specified herein.
- B. Verify system requirements with local Telephone Company prior to installation.

#### 2.00 PRODUCTS

##### 2.01 MATERIAL

- A. Conduit system shall be as specified under section labeled "Raceways".
- B. Outlets shall be four inch square or 4-11/16" square (for 1-1/4" conduit) galvanized pressed steel boxes, single gang plaster frame and blank plate to match other devices.

#### 3.00 EXECUTION

- A. Provide main service conduit as indicated. Maintain minimum 24 inch separation from electrical power service. Conduit shall be PVC Schedule 40 and run continuous from the Main Telephone Terminal Board to the TELCO Closure on the site. The conduit shall be placed a minimum of 30" below grade. All conduit feeders shall terminate on the extreme left hand corner of the terminal board. Conduit runs shall not contain condulets or pull boxes, and runs from point-to-point shall contain not more than three 90 degree five foot long 36" radius bends.
- B. Provide telephone outlets for connection to elevator car telephones. Verify location with elevator manufacturer.
- C. Provide ground for ground connection near each telephone terminal board.
- D. Provide pull line in all empty conduits.

**END OF SECTION**



## SECTION 28-3100

### FIRE DETECTION AND/OR ALARM SYSTEM

#### PART 1 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. The Contractor shall furnish all labor, equipment and materials necessary for the installation of a complete fire alarm and/or detection system as indicated on the drawings and that meets all local fire department codes and ordinances.
- B. The system shall be annunciated per each device, electrically supervised, connected, tested and left in first class operating condition.
- C. The contract drawings show the location of controls, alarm actuating devices and audible alarm signaling devices. All wiring shall be as shown on the fire system supplier's installation shop drawings.
- D. All equipment herein specified shall comply with the applicable provisions of the following current National Fire Protection Association (NFPA) Standards:
  - NFPA (All applicable sections)
  - Life Safety Code No. 101 (When applicable)
- E. All equipment, devices, etc. shall be listed by Underwriters Laboratories and/or Factory Mutual.
- F. The system shall comply and operate with respect to all local and state codes, with no exceptions and the Main Fire Alarm Control Panel Electronics shall function to make the complete Fire Alarm and/or Detection System to operate in a manner as required by the authorities having jurisdiction.
- G. To establish the type and quality of the system desired, the equipment specified is that of Simplex Corporation. All other suppliers must submit a request for substitution approval accompanied by literature on the equipment in questions. Request for approval must be submitted at least ten days prior to bid.
- H. The system shall be a fully addressable multiplex type system with each detector and device addressed separately and a fully annunciated fire alarm system and interconnected to an outside monitoring company and/or central station as required by the local authority. The system shall include a autodialer and connection to the local phone system unless other arrangements have been made by the owner.
- I. The contractor shall submit a full set of manufacturers shop drawings and design layout for approval by the fire department having jurisdiction and the engineer prior to any work being performed in the field.
- J. Submit shop drawings with all information as described on the project drawings.
- K. Provide the owner with complete O & M Manuals on this system at the completion of the project.
- L. SYSTEM OPERATION
  - 1. Actuating devices shall be displayed on the "LED" display unit that are located on both the Main Fire Alarm Control and Remote Annunciator Panel. Each device shall be displayed by room name, number and address both on the "LED" displays and on the graphic panel and/or plaque. Furnish and install non-lit BACKLIT graphic phenolic plaque, one mounted on the Main Fire Alarm Control Panel (Size and mount in space available) and one adjacent to the Remote Annunciator Panel, located per the local fire department. This plaque shall be based on the project floor plans and shall be framed and under glass or engraved and colored on a sheet of white plexiglass.
  - 2. The Main Fire Alarm Control Panel shall contain all required electronic modules as required to make the system operate as required by the local authorities and these plans and specifications. There shall also be an adequate quantity of zoned auxiliary relay contacts to provide interfacing with equipment as indicated on the drawings.

3. The input modules shall provide alarm and trouble indications by zone. Actuation of an alarm initiating device shall be displayed on the "LED" displays at both the Main Fire Control Panel and at the Remote Annunciator Panel. The visual alarm indicator shall remain illuminated until the system has been restored to the normal operating mode. If there is a backlit graphic panel the appropriate light shall go on for each device in alarm.
4. The Main Fire Alarm Control Panel shall be supplied with an alarm silence/acknowledge switch which will silence the audible alarms. Should a subsequent alarm of a different zone occur, the alarm devices will resound until silenced or the control panel is reset. This can be performed without turning off the strobe units.
5. When an alarm condition is encountered, the Fire Alarm Control Panel shall continuously activate all audible and visual alarm indicators throughout the building until the alarm silenced switch is activated or the Control Panel is returned to its normal operating status.
6. The system control panel shall provide the correct operating module which shall be capable of automatically transmitting fire information to the fire department, local monitoring company and/or a central station. The Contractor shall coordinate the correct module prior to purchase of the system. Arrangements for this connection shall be made by the Owner. This contractor shall provide a conduit from the Main Telephone Terminal Board to the Fire Alarm Control Panel for this connection as indicated on the drawings. The main fire alarm control panel shall also include an autodialer and modem as required to make the system operational.
7. Each alarm initiating circuit, horn/strobe circuit and fire department interfacing circuit shall be supervised. Any disarrangement of the system wiring such as loss of power, opens or grounds shall initiate the audible and visual trouble indicators. The trouble lamp illumination shall be non-calling except by an actual clearing of the trouble condition. The audible trouble signal may be silenced by use of a trouble silence switch which incorporates the ring-back feature.
8. The Main Fire Alarm Control Panel shall derive its primary operating power from a 120VAC single phase 60Hz supply. Contractor to include more than one 20 amp power circuit if so required. There shall also be a 24 VDC Battery standby power source capable of operating the alarm devices for a minimum of 24 hours in a standby mode and for fifteen (15) minutes in a full alarm condition. The Fire Alarm Supplier/Manufacturer shall size the battery system to accomplish the required battery system capacity as stated above.
9. A green pilot LED shall normally be on, indicating that the system is receiving normal 120VAC power. Failure of normal power shall cause the LED to go out.
10. A trouble LED and horn, operating together, shall signal any trouble condition. Failure of normal power, open shorts, ground faults on the indicating circuit, disarrangement's in system wiring, or grounds shall cause the trouble LED to light and the horn to sound. A silencing switch shall be so arranged that the trouble LED will remain lighted until the system is restored to normal. When the system is restored to normal, the audible portion shall resound to remind service personnel to return the switch to the normal position.
11. All alarm signals shall be automatically locked in at the control panel until the operated devices are returned to their normal condition, and the control panel is manually reset. A switch shall be provided in the control panel for silencing the alarm devices. Once silenced, this shall not prevent the resounding of all alarms from another zone in alarm if an additional alarm condition should occur elsewhere in the building. Unless other noted on the drawings or indicated in these specifications, the strobe lights shall operate independently of the horns. There shall be a silence switch in the Fire Alarm Control Panel as described above for the horn circuits only. The strobe lights shall continue to flash until the system is cleared of an alarm signal.
12. Each initiating circuit shall be represented on the zone cards and the Main Control Panel by an amber color LED and a red color alarm LED. The LED's for each zone shall be identified on the control panel by a lettered nameplate showing the zone designation. Circuit trouble shall be indicated by the amber LED and alarm by the red LED. In lieu of the above, direct LCD readout is acceptable for all zoning information.

13. Upon activation of the sprinkler system and the flow switch sends a signal to the Main Fire Alarm Control Panel, it shall operate the exterior horn and strobe light and all interior horns and strobes. The interior horns and strobes may be silenced by authorized personnel, but as long as water is flowing, the exterior horn and strobe will remain on. The above mentioned exterior horn and light shall be rated 24VDC and will obtain all power from the Fire Alarm Control Panel.
14. When there is a sprinkler system with a supervised tamper switch, the Main Fire Alarm Control Panel shall constantly monitor this unit. If the tamper switch is moved, the Main Fire Alarm Control Panel shall indicate trouble and send a signal to the outside monitoring unit. The tamper switch shall be installed on a separate monitored zone and where required by local codes shall have a different sound signal at the Fire Alarm Control Panel than the sound made by a normal trouble signal.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

#### **A. MAIN FIRE ALARM CONTROL PANEL**

1. The Control Panel Cabinet(s) shall be constructed with heavy gauge steel meeting UL 864f. It shall be suitable for surface or flush mounting as indicated on the drawings and painted red in color. This one panel shall contain all equipment and batteries and power supplies as required to make the system fully operational. If the supplier cannot accomplish this function, the separate cabinets shall be located per the engineer's directions without any additional costs to the project. The contractor will include in their bid all associated costs for this separate cabinet and conduit and wire as required.
2. The Control Panel shall consist of modular unit-type assemblies mounted on channels facilitating easy removal for repair and ease of expansion. Inter-module wiring for common system functions shall be via a supervised bus. Disarrangement of that bus shall cause a trouble condition at the common control module.
3. The common control module shall provide power and the main core functions for monitoring, interpreting and automatically controlling the fire alarm system.
4. The Control Panel shall contain a power transfer circuit that will switch to standby power automatically and instantaneously if normal power fails.
5. The Control Panel shall contain a fully automatic, adjustable rate, constant current battery charger which shall be capable of charging a nominal 40 amp hour battery to full charge in 15 hours. The charger operates on a demand basis at a trickle charge or automatic high rate. Supervision is provided for low battery voltage and no voltage conditions. These trouble conditions will activate common trouble circuits, light the BATTERY LED, and sound the system trouble alert tone. When the charger is in the high rate mode the BATTERY LED will also light, but will not sound the trouble tone or report trouble via the line reversal circuit. The charger shall be compatible with sealed lead acid, sealed NiCad batteries.
6. The Fire Alarm Control Panel shall contain the following switches:
  - a. Reset Switch
  - b. Alarm Silence Switch for the complete system. Will turn on the Alarm Silenced LED as long as it is in off normal position.
  - c. Trouble Silence Switch for the complete system. Silences the trouble alert, returns trouble relay to normal state and activates Trouble Silenced LED.
  - d. City Box Disconnect Switch. Prevents alarm information from being sent out to Fire Department or private monitoring company. Activates appropriate LED.
  - e. Drill Switch. Will cause fire drill by activating alarm output modules.
  - f. Lamp Test Switch.

- g. Alarm off Switch. Disconnects all audible devices from the system.
  - h. Battery Test Switch. It shall disconnect the power supply and operate all alarm devices from standby batteries, without sending a signal to the monitoring company or the Fire Department.
7. The Fire Alarm Control Panel shall contain the following LED's (quantities as specified elsewhere in these specifications):
- a. A.C. Power On (Green)
  - b. Alarm (Red)
  - c. Alarm Silenced (Red)
  - d. Trouble Active (Red)
  - e. Trouble Silenced (Red)
  - f. Trouble Switch (Yellow) A switch is in the incorrect position.
  - g. Trouble Input (Yellow) An input zone is in the trouble condition.
  - h. Trouble Output (Yellow) An output zone is in the trouble condition.
  - i. Trouble Internal (Yellow) A continuity supervision trouble exists.
  - j. High Charge (Red) Battery charger is on automatic high rate.
  - k. Trouble Ground (Red) A wiring ground fault exists.
  - l. Low Voltage in Battery (Red)
8. The Fire Alarm Control Panel shall contain the following meters for use with the Batteries and Battery Charging System. The meters shall be calibrated with respect to the system actually being installed.
- a. Battery Ammeter
  - b. System Voltmeter
  - c. System Ammeter
9. The Fire Alarm Control Panel shall contain lightning protection as required to protect all system components and will include a separate transient surge suppression device for component protection.
10. The fire alarm system shall provide the alarm code sound system as required by NFPA and the local codes.

#### B. BATTERIES

Shall be of sufficient capacity to provide power for the entire system upon loss of normal 120VAC power for a period of 24 hours with 15 minutes of alarm indication at the end of this 24 hour period.

#### D. REMOTE ANNUNCIATOR PANEL

1. There shall be a flush mounted in the wall in a location as shown on the drawings and as approved by the fire department prior to any roughin a Remote "LCD" Display type annunciator panel.
2. The panel shall be Vandal Resistant under all conditions and weatherproof if so indicated on the drawings by being shown outdoors.
3. The unit will contain an 80 character, back-lit alphanumeric, Liquid Crystal Display that provides clear english language information as to the FACP status (alarm, trouble, etc), type of alarm (smoke detector, pull station, etc.), number of alarms, supervisory conditions and troubles in the system, room name and number and the mapnet number of the device.

#### E. MANUAL PULL STATIONS

The manual pull stations (red in color) shall be single action with normally open alarm contacts. Once activated it must be clearly visible which station was activated. Stations shall not be resetable without the use of a special tool and physically opening the station to reset. Provide two such tools to the owner.

The specification number shall be shown on the project drawings.

#### F. HORN/STROBE LIGHTS

The horn/strobe light combination shall consist of a vibrating horn (90db, 24VDC), and visual indicating device. The light shall be a 24VDC Xenon Flasher with a white lens and red lettering labeled "FIRE" and made of lexan type material. Both horn and light shall operate at the same time except they shall be zoned separately. The lamp assembly is to be shock mounted to prevent filament destruction due to vibration from the horn. Xenon Flasher 500 hour life, 24VDC, 70ma Horn 21-28VDC, 35ma. This device shall meet all "ADA" requirements.

The specification number shall be shown on the project drawings.

#### G. HEAT DETECTORS

1. Heat detectors shall be low profile with normally open alarm contacts. They shall be combination rate of rise, and/or 135 Degree fixed temperature devices. The detectors shall also contain a set of contacts to activate a remote indicating device when the detector is activated. This relay is only required when shown on the drawings.
2. In areas with high ambient temperatures, 200 Degree elements shall be provided they will be so indicated on the drawings.

The specification number shall be shown on the project drawings.

#### H. SMOKE DETECTORS

Photoelectric type smoke detectors shall operate as two wire detectors and have an LED output upon alarm. All detectors shall be able to activate a remote indicating device when the detector is activated. This relay is only required when shown on the drawings. The detector shall be non-polarized. Voltage and RF transient suppression techniques shall be employed to minimize false alarm potential. A smoke signal verification feature shall be used for additional detector stability. The vandal-resistant, security locking feature shall be used in those areas as indicated on the drawings. The locking feature shall be field removable when not required.

The specification number shall be shown on the project drawings.

#### I. IONIZATION DETECTORS

These detectors shall be dual chamber design of two piece configuration with detector head and separate twist lock base. Bases for ionization and photoelectric detectors shall be interchangeable. The detectors shall have a flashing, status indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brilliance. The detector may be reset by actuating the control panel reset switch. All detectors where indicated on the drawings shall have an auxiliary relay to activate a remote indicating device when the detector is activated.

The sensitivity of the detector shall be monitored without removal of the detector head. Metering test points shall be accessible on the exterior of the detector head. Field adjustment of the sensitivity shall be possible when conditions require a change. The vandal-resistant, security locking feature shall be used in those areas as indicated on the drawings. The locking feature shall be field removable when not required.

It shall be possible to perform a functional test of the detector without the need of generating smoke. The test method must simulate effects of products-of-combustion in the chamber to assure testing of all detector circuits.

To facilitate installation, the detector shall be non-polarized. It shall be possible to check the detector circuit loop continuity prior to installing the detector head. Voltage and RF transient suppression

techniques shall be employed to minimize false alarm potential. A rated alarm output shall be used for additional stability.

The specification number shall be shown on the project drawings.

J. DUCT PHOTOELECTRIC SMOKE DETECTORS

Duct smoke detectors shall be of the photoelectric, light-refraction type with the detection chamber directly in the air stream of the duct. Detectors shall operate from system voltage. Detection shall occur with 1% to 3% smoke obscuration in the detection chamber. The detectors shall lock in on an alarm condition. A removable "Normal-Reset-Test" key switch shall be provided on each detector to control its operation. The detectors shall have SPST alarm contacts and 3 SPDT contacts. Contacts shall be rated at 10 amperes, resistive load.

The specification number shall be shown on the project drawings.

L. REMOTE TEST STATION

Shall consist of a single gang stainless steel cover plate with the following items located on it's face:

\*\*One LED indicating the unit is receiving power from the FACP

\*\*One LED indicating the unit is in alarm. The LED will lock on when in the alarm mode and remain on until the smoke detector no longer detects smoke.

\*\*A key switch with one position for normal operation and the other position is a momentary contact for testing the detectors.

\*\*The plate shall also be labeled (Engraved and red in color) as to the unit's name to which it is connected.

The specification number shall be shown on the project drawings.

**PART 3 EXECUTION**

A. DO NOT INSTALL any detector heads until the construction is 100% complete and cleanup is complete. If installed prior to this, all detector heads shall be enclosed in plastic bags so as not to allow any dirt inside to the detector head. These bags will not be removed until cleanup has been completed.

B. DO NOT INSTALL any detector heads within 18 inches of any fluorescent fixture ballast.

DO NOT INSTALL any detector heads within 12 to 18 inches of any HVAC diffuser.

C. GENERAL WIRING REQUIREMENTS

1. All wiring shall be solid copper conductors and NOT stranded

2. Contractor shall not pull wires through conduits with live circuits.

3. Wires in controls panels and annunciator panels are to be landed on numbered terminal strips with one conductor per screw terminal pressure connector. Arrange wiring neatly using clips and harnesses as required. Identify conductors and the terminal landed upon. Include wiring diagrams on inside cover of panels and in O&M's.

4. Color Coding and wire sizes for fire alarm system as follows, all wire is solid copper:

Circuit Type	Colors	Wire Size
Fire Alarm Zones	Red + \ Black -	14 THHN
Mapnet	Red + \ Black -	18 Twisted Shielded
Communications lines	White/Red + Black -	18 Twisted Shielded
Audio Risers (panel to floor)	Red + \ Black -	12 Twisted Shielded

Terminal cabinet / or floor			
Floor to floor riser)			
Horns	Yellow + \ Black -		14 THHN
Strobes (visual)	Yellow + \ Black -		14 THHN
Speakers (floor wiring-riser	Red + \ Black -		14 Twisted Shielded
To device)			
Annunciators	White/Red + Black -		18 Twisted Shielded
Communications			
Remote Test Switches	White \ White		14 THHN
Remote Fire Fighters Reset	Blue \ Blue		14 THHN
Remote Fire Fighters Signal	White \ White		14 THHN
Silence			
Remote Fire Fighters Trouble Light	Yellow		14 THHN
Remote Fire Fighters Alarm Light	Red		14 THHN
Remote Fire Fighters Lamp Common	Black		14 THHN
Elevator Recall Primary	Purple \ Purple	14 THHN,	
Elevator Recall Alternate	Silver \ Silver		14 THHN

D. FIELD QUALITY CONTROL

1. All contractors shall have documented a minimum of five years of commercial or industrial fire alarm installation experience. Journeyman shall have a minimum of two years documented fire alarm installation experience. Documentation shall be submitted if requested.
2. Require that all wiring be done by experienced personnel under supervision of manufacturer's representative. The fire alarm equipment supplier shall make a through inspection and test of the completed fire alarm system prior to final interconnection to a central station. This inspection and test shall be documented and given to the engineer.

E. FINAL ACCEPTANCE TESTING

1. Before final interconnection, the contractor shall perform a complete system check with the manufacture's technician present. This testing shall be completed without the involvement of the owner and prior to scheduling the final testing with the Fire Department. This testing shall include setting every detector into alarm individually, operating each pull station, operating all audible systems, operating all functions in the FACP, etc. After this testing has been completed and accepted by the Fire Department, the contractor shall prepare a letter to the engineer providing proof of this acceptance by the fire department.
2. As a final test the contractor and a manufacturer's technician shall demonstrate to the design engineer and the Owner's representative that the system is in full operational status. This demonstration shall include testing 100% of the devices and/or systems as directed by the design engineer and witnessed by the owner's representative. The contractor shall furnish all test equipment necessary including an electric detector tester and canned smoke to set the detector into an alarm condition.

F. INSTALLATION DOCUMENTATION FOR FINAL ACCEPTANCE:

1. Operating and maintenance manuals shall be furnished as specified herein. Four manuals for each fire alarm system and four sets of drawings shall be provided. One copy shall be encased in an accessible plastic envelope permanently affixed to each fire detection and alarm system control panel. All other copies shall be delivered with the final indexed copies of approved shop drawings and catalog data in a hardback 3-ring binder which is clearly labeled to designate the building for which it is intended. Manuals shall be as approved by the Engineer.
2. As-Built Drawings: Complete, reproducible original drawing size as-builts plans, four sets of drawings and CAD disks showing conduit routing and number of conductors per conduit. Show all devices including known future devices and indicate as such.

As-built point to point wiring depicting every device, CAD backgrounds provided by the Architect or Engineer, complete with room numbers. Revised schematic, wiring and interconnection diagrams of all circuits, internal and external, for all equipment installed and exact locations for all devices. Provide manufacturer's technical information drawings. These schematics shall include the conductor color coding and terminal number identification system, location of all terminal boxes complete with numbering and each device address.

Complete, as-installed, riser diagrams indicating the wiring sequence of all alarm initiating devices, supervisory devices, and all signaling appliances on all signaling circuits.

A complete description of the system operation, including a schedule of relay abbreviations used on the drawings, list of relay functions, and the sequence of relay operation during supervisory trouble and alarm conditions.

Complete wiring and control diagrams for control and shutdown circuits for fan systems.

Completed Certificate of compliance and testing as required by the local fire department.

The engineer may walk through the building and spot check 5 - 10% of the device locations against the as-builts. If the devices are not as shown, the drawing shall be rejected for a re-draw. Upon re-submittal, another spot check will be done. If deficiencies are still found, an independent audit to the system by the system manufacturer will be required and the cost of the audit will be the responsibility of the installing contractor.

#### G. GENERAL OPERATION AND MAINTENANCE PROCEDURES

1. Conduct instruction to the owner's representative on all normal maintenance and trouble shooting procedures down to the circuit board level of equipment included in the contract (minimum of eight hours per new system).
2. Provide complete factory training (component and programming) for the owner and/or their representative. Include transportation, lodging and one meal per day.

**END OF SECTION**