

**SPECIFICATIONS  
COVERING  
THE  
NEW PAVILION IMPROVEMENTS AT HADDON LAKE PARK**

**BOROUGH OF HADDON HEIGHTS  
CAMDEN COUNTY, NEW JERSEY**

**Bid Number: A14-24**

**CAMDEN COUNTY PARKS  
CAMDEN COUNTY, NEW JERSEY**

**MARCH 2024**

**Prepared By:**



**REMINGTON & VERNICK ENGINEERS, INC.**  
2059 Springdale Road  
Cherry Hill, New Jersey 08003  
856-795-9595  
[www.rve.com](http://www.rve.com)

**OUR FILE #0400T031**

*Jessica D. Hauber*  
**Jessica D. Hauber, P. E. - Lic. No. 51487**

3/6/2024

**DATE**

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**INVITATION TO BID  
FOR BID #A14-24  
CAMDEN COUNTY DEPARTMENT OF PARKS  
NEW PAVILION AT HADDON LAKE PARK**

Notice is hereby given that sealed bids for **Bid #A14-24, New Pavilion at Haddon Lake Park** will be received, opened and read in public at the Camden County Courthouse, **1<sup>st</sup> Floor Lobby**, 520 Market Street, Camden, New Jersey 08102 on **Wednesday, April 10, 2024 at 11:00 AM** prevailing time by the Camden County Purchasing Agent or her designee.

It is recommended that each bid be sent by U.S. Mail to the Camden County Division of Purchasing, Courthouse 6<sup>th</sup> Floor, 520 Market Street, Camden, NJ 08102. If hand-delivered, bids must be left in the bin accessible from the 6<sup>th</sup> Street entrance of the Courthouse at 520 Market Street, Camden, NJ 08102. Bin access is 8:30 AM to 4:00 PM only. The County assumes no responsibility for delays in any form of carrier, mail or delivery service causing the bid to be received at the **Division of Purchasing** later than the above-referenced scheduled opening.

Electronic Copies of the Bid Documents may be obtained by contacting Remington & Vernick Engineers via email at [RVEbidinterest@rve.com](mailto:RVEbidinterest@rve.com) or by phone at (856) 795-9595. There is no charge for obtaining an electronic copy of the Bid Documents.

**All Requests for Information (RFI) must be submitted by email to Ms. Jessica Hauber at [jessica.hauber@rve.com](mailto:jessica.hauber@rve.com) by Monday, March 25, 2024 at 12:00 PM.**

Bidders are required to comply with the requirements of P.L. 1975, c. 127 (N.J.A.C. 17:27) and N.J.S.A. 10:5-31 et seq.

Bidders are required to comply with the requirements of P.L. 1999, c. 238 (N.J.S.A. 34:11-56.48 to 57), where applicable.

All bidders are responsible for obtaining complete bid documentation from the County at the website listed above. In the event of any inconsistencies between this advertisement, as published, and the bid documentation, the bid documentation shall control.

By order of the Commissioners Board of Camden County, New Jersey.

Anna Marie Wright,  
Camden County Purchasing Agent

**CAMDEN COUNTY DIVISION OF PURCHASING  
COURTHOUSE - 6TH FLOOR  
520 MARKET STREET  
CAMDEN, NEW JERSEY 08102-1375  
(856) 225-5439**

DATE: March 14, 2024

Bid No. and Title:

A14-24: New Pavilion at Haddon Lake Park

BIDS MUST BE RETURNED NO LATER THAN 11 O'CLOCK, PREVAILING TIME  
ON April 10, 2024.

1. PRICES MUST INCLUDE DELIVERIES TO ALL SITES SET FORTH HEREIN.
2. Quotations must be made on these sheets. Camden County is not responsible for any expenses incurred by any firm in preparing or submitting a bid proposal.
3. Prices may be submitted on any or all the items listed unless otherwise specified. Award of contract for goods and services will be made based on the lowest responsible bid on each item or on an aggregate basis, whichever is in the best interest of Camden County and System Members (if this is a Cooperative Pricing bid).
4. Insert NET UNIT PRICES. Bids must be firm for a minimum of 60 days. Contract prices may not be increased during the term of the contract.
5. Camden County and System Members are exempt from sales tax.
6. The County of Camden reserves the right to accept or reject any part or parts of the responses to this bid in accordance with law.
7. To the extent that any of these instructions directly contradict the bid specifications, the bid specifications shall prevail.
8. The County of Camden shall only be responsible for the payment of interest or late fees as provided pursuant to N.J.S.A. 2A:30A-2(c).
9. Official County bid packages for routine goods and services are available from the Camden County Division of Purchasing at no cost to the vendor. (Bids for highway projects are issued by that department for a fee). All addenda are issued by the Division of Purchasing (or Highway department if applicable). **Potential bidders are cautioned that they are bidding at their own risk if a third party supplied the bid specifications.** Such specifications may or may not be complete. The County is not responsible for third party supplied bid specifications.
10. Bidders are required to comply with the requirements of P.L. 1999, c. 238 (N.J.S.A. 34:11-56.25 et seq.) regarding prevailing wages, where applicable.

11. Bidders are hereby noticed that the County shall correct certain types of clerical errors if found in submitted bids. For example, if the quantity needed or the standard unit of measurement used, times the unit price, is incorrectly calculated in reaching a total or final price, the County will correct the computational mistake.
12. The County requires bidders to list any exceptions to the bid specifications. For any exceptions listed the County shall determine if it will accept an immaterial, or minor, deviation from its bid specifications as permitted by law. Material exceptions shall be cause for rejection of the bid. Bidders shall not be permitted to remove listed exceptions.
13. N.J.S.A. 40A:11-2.1 and 52:32-55 prohibits State and local public contracts with persons or entities engaging in certain investment activities in energy or finance sectors of Iran.
14. Official notification of contract awards authorized by the County may be viewed on camdencounty.com. To review, click on the gold "Your Government" tab, scroll to the information box on the left and click on "County Public Information", then click on "Commissioner Meetings". Meetings and agendas are found here. Click on "Commissioner Meeting (AGENDA)" for the month you would like to view. Copies of resolutions and bid results require an OPRA request. See camdencounty.com for OPRA form and process.
15. Should any requirements or language contained in the contract documents/technical specifications be found to conflict with the County's general bid boilerplate (ITB pages), the requirements/language in the bid boilerplate shall prevail.
16. BIDDERS ARE REQUIRED TO USE THE COUNTY'S FORMS AND SHALL NOT RECREATE IN ANY WAY THE FORMS PROVIDED WITH THIS BID. FAILURE TO USE THE COUNTY FORMS OR ADDING TO, AMENDING, ALTERING, OR REVISING THE COUNTY FORMS, INCLUDING, BUT NOT LIMITED TO, CONVERTING THE COUNTY PDF OR HARDCOPY TO A WORD DOCUMENT, SHALL BE CAUSE FOR REJECTION OF THE BID.

WE SUBMIT HEREWITH our prices as indicated on the following bid.

Submitted on \_\_\_\_\_, 20\_\_\_\_ BY \_\_\_\_\_  
 (Name of Company)

Fax No. \_\_\_\_\_ PER \_\_\_\_\_  
 (Signature and Title of Authorized Representative)

E-Mail: \_\_\_\_\_ Phone No. \_\_\_\_\_

## BIDDER'S CHECKLIST

**THIS BIDDER'S CHECKLIST MUST BE COMPLETED, SIGNED AND SUBMITTED WITH YOUR BID PACKAGE.**

1. Bid Guarantee deposit in the form of a certified check, cashier's check or bid bond. See Paragraph 4.1 and **Exhibit A**. (Must be submitted with bid) \_\_\_\_\_
  
2. Certificate from a Surety Company or Financial Institution stating that if bid is accepted, they will provide the required performance bond or Letter of Credit. See Paragraphs 4.2, 8.1 and 8.2, and **Exhibits B, C, and D**. (Must be submitted with bid, **must include originals – copies will not be accepted**) \_\_\_\_\_
  
3. Statement of Corporate Ownership listing the names and addresses of all individuals owning ten percent (10%) or more of corporation, partnership or LLC. See **Exhibit E**. (Must be submitted prior to or with bid) \_\_\_\_\_
  
4. Non-collusion Affidavit properly notarized. See **Exhibit F**. \_\_\_\_\_
  
5. Affirmative Action Questionnaire with available evidence submitted. See Paragraph 5 and **Exhibit I**. \_\_\_\_\_
  
6. Affirmative Action MBE/WBE Tracking Form. See Paragraph 5 and **Exhibit J**. \_\_\_\_\_
  
7. Debarment Certification Form. **Federal Public Works contracts only**. See **Exhibit K**. N/A \_\_\_\_\_
  
8. Extension or Non-Extension of Prices to Registered System Members (Other Agencies) See Paragraph 22.1 and **Exhibit L**. N/A \_\_\_\_\_
  
9. Textile/Apparel Subcontractor Disclosure Requirements  
  
**For Bids for Textiles and/or Items of Apparel Only.**  
Disclosure of all subcontractors and sites and Certification of Compliance for textile and apparel bids. See Paragraphs 23.1 and Paragraph 23.2 and **Exhibit M**. (Must be submitted with bid). \_\_\_\_\_

**[BIDDER'S CHECKLIST CONTINUED NEXT PAGE]**

**BIDDER'S CHECKLIST (cont'd)**

- 10. Proof of compliance with The Public Works Contractor Registration Act, if applicable. See Paragraph 24. (Must be submitted prior to awarding of contract). \_\_\_\_\_
  
- 11. Construction Subcontractor Disclosure Requirements
  - a. **For Bids for Construction Only.**  
Disclosure of subcontractors as required by N.J.S.A. 40A:11-16. See Paragraph 26 and **Exhibit N**. (Must be submitted with bid) \_\_\_\_\_
  
- 12. Proof of compliance with the State Contractor Business Registration Program. See Paragraph 31. \_\_\_\_\_
  
- 13. Acknowledgement of Receipt of Addenda, whether or not issued, N.J.S.A. 40A:11-23.2. See Paragraph 32 and **Exhibit Q**. (Form must be submitted with bid). \_\_\_\_\_
  
- 14. Uniformed Law Enforcement Officer requirement form. **Exhibit R**. \_\_\_\_\_ N/A \_\_\_\_\_
  
- 15. Certification - Disclosure of Investment Activities in Iran **Exhibit S**. (Must be submitted prior to award of contract). \_\_\_\_\_
  
- 16. Certification of non-involvement in prohibited activities in Russia or Belarus. **Exhibit T**. (Must be submitted prior to award of contract). \_\_\_\_\_

\_\_\_\_\_  
**NAME OF BIDDER**

\_\_\_\_\_  
**SIGNATURE**

\_\_\_\_\_  
**DATE**



## INSTRUCTIONS TO BIDDERS

### 1. RECEIPT, OPENING, WITHDRAWAL OF BIDS, AND FAILURE TO RESPOND

- 1.1 Sealed Bids will be received by the County on the date, time, location, and in the manner as listed in the advertisement.
- 1.2 Bids must be received at the Camden County department stipulated in the advertisement no later than the due date and time indicated therein. It is recommended that bids be hand delivered to that department. The County assumes no responsibility for delays in any form of courier or mail order delivery service causing the bid to be received at the **department stipulated** later than the due date and time. All late bids will be rejected in accordance with the law.
- 1.3 Any bid may be withdrawn prior to the time for openings of bids or the authorized postponement thereof. Any bid received after the opening of bids will not be considered. No bidder may withdraw a bid within sixty (60) days after the actual opening thereof.

### 2. QUALIFICATION OF BIDDERS

- 2.1 The County may make such investigation as it deems necessary to determine the ability of the bidder to perform the work and the bidder shall furnish to the County all such information and data for this purpose as the County may request. The County reserves the right to reject any bids if the evidence submitted by, or investigation of such bidder, fails to satisfy the County that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated herein.

### 3. PREPARATION OF BID

- 3.1 **Bids must be submitted on the prescribed form. ONE ORIGINAL (1) AND TWO (2) COPIES** of the bid should be submitted. The bidder shall fill in all blank spaces in ink or by typewriter, both in words and figures. Bids must be signed in ink by authorities with capacity to legally bind the bidder to its bid proposal.
- 3.2 Each bid shall be based upon the specifications prepared by the County. The bidder accepts the obligation to become familiar with the County's specifications.
- 3.3 Each bid must give the full business address of the bidder and be signed by an authorized representative. Bids by partnerships must furnish the full name of all partners and must be signed in the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the person signing. Bids by corporations must be signed in the legal name of the corporation, followed by the name of the State of Incorporation and must contain the signature and designation of the President, Secretary or other person authorized to bind the corporation in the matter. When requested by the County, satisfactory evidence of the authority of the officer signing on behalf of the corporation shall be furnished.
- 3.4 Bids containing any conditions, omissions, unexplained erasures or alterations, items not called for in the proposal form, attachment or additive information not required by the bid documents, or irregularities of any kind, may be rejected by the County. Any changes, white-outs, strike-outs, etc. on the proposal page must be clear as to meaning and initialed by the person responsible for signing the bid.

- 3.5** The County reserves the right to waive any minor informalities in the bids received as permitted by law or reject bids under certain circumstances as permitted by law.
- 3.6** All bids must be submitted in sealed envelopes bearing on the outside the name of the bidder, address and subject and title of the specifications. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope, addressed as set forth in the advertisement. The County assumes no responsibility for mailings not received on time at the department stipulated in the advertisement to receive bids. It is therefore recommended that bids be hand delivered.
- 3.7** Bidders must insert prices for furnishing all the materials and/or labor required by these specifications whether such requirement is specifically set forth. Prices shall be net, including any charges for packing, crating, containers, etc. and all transportation charges fully pre-paid by the contractor F.O.B. destination and placement at locations specified by the County. No additional charges will be allowed for any transportation costs resulting from partial shipments made at the contractor's convenience when single shipment is ordered.
- 3.8** Payments will be made upon the approval of vouchers submitted by the successful bidder in accordance with the requirements of the Board of Commissioners and subject to the County's customary billing procedures.
- 3.9** The County reserves the right to grant up to three (3) business days' additional time to bidders after the bid opening to provide the following documents required by the bid specifications:
- a. Non-collusion affidavit. See **Exhibit F**;
  - b. Affirmative Action Questionnaire with available evidence submitted. See Paragraph 5 and **Exhibit I**;
  - c. Affirmative Action Plan MBE/WBE Tracking Form. See Paragraph 5 and **Exhibit J**;
  - d. Debarment Certification Form – for Federal Contracts – Public Works only. See **Exhibit K**.

Such additional time may not in any way affect the price or cost of the bid. All other documents required by the bid specifications must be submitted at the time of the bid opening specified herein or in accordance with law.

#### **4. BID BOND/CONSENT OF SURETY OR LETTER OF CREDIT**

##### **4.1 BID BOND**

Each bid must be accompanied by the Certified Check of the bidder or by a Cashier's Check, or by a Bid Bond prepared on the form of bid bond attached hereto as **Exhibit A**, duly executed by the bidder as principal, having surety thereon, a surety company approved by the County, in an amount not less than ten percent (10%) of the amount of the base bid submitted, said 10% not to exceed \$20,000.00 pursuant to N.J.S.A. 40A:11-21, payable to the Treasurer, Camden County. Only originals submitted on the County's form Exhibit A will be accepted.

#### 4.2 CONSENT OF SURETY OR LETTER OF CREDIT

In addition, the bid must also be accompanied by a Certificate (Consent of Surety) from a Surety Company stating that it will provide said bidder with a Performance Bond in the full amount of the bid. County forms are required to be used. A form of Consent of Surety is attached hereto as **Exhibit B**. Only originals submitted on the County's form Exhibit B will be accepted. A form of Performance Bond is attached hereto as **Exhibit C**. **Exhibit C must be signed by the successful bidder and bidder's surety after award of contract and must be returned with the contract.** As an alternative to the consent of surety, bidders may provide a letter from a bank or similar financial institution stating that it will issue a Letter of Credit in the full amount of the bid and pursuant to the terms of the Letter of Credit in the specifications (See **Exhibit D**). **This Letter of Credit option is not available on bids exceeding \$100,000. Such bids require a Consent of Surety/Performance Bond. See N.J.S.A. 40A:11-22.**

4.3 Per N.J.S.A. 40A:11-24(a), All bid security, except the security of the three apparent lowest responsible bidders, shall be returned, unless otherwise requested by the bidder, within ten (10) days after the opening of bids, **Sundays and holidays excepted**, and the bids of such bidders shall be considered as withdrawn. Within three (3) days, **Sundays and holidays excepted**, after the awarding and signing of the contract, and the approval of the contractor's performance bond, the bid security of the remaining unsuccessful bidders shall be returned to them.

4.4 In accordance with N.J.S.A. 40A:11-14 the County requires the bid bond and consent of surety in the form provided herein on Exhibit A and Exhibit B. No other forms shall be accepted and failure to provide a bid bond and consent of surety on the County form, when required by the bid, shall be cause to reject the bid.

#### 5. AFFIRMATIVE ACTION

5.1 The successful bidder shall adhere to the mandatory affirmative action language required by P.L. 1975, c.127 (N.J.A.C. 17:27) and N.J.S.A. 10:5-31 et seq.

5.2 For procurement, professional and service contracts, the above-referenced mandatory language shall be that set forth in **Exhibit G**.

5.3 For construction contracts, the above-referenced mandatory language shall be that set forth in **Exhibit H**.

5.4 All bidders should complete the Affirmative Action Questionnaire set forth in **Exhibit I** and follow its instructions.

5.5 All bidders should complete the Affirmative Action Plan MBE/WBE Tracking Form in **Exhibit J**.

#### 6. ADDENDA AND INTERPRETATIONS

6.1 No interpretation of the meaning of any bid document will be made to any bidder orally. Any request for interpretation shall be in writing, addressed to the County's representative stipulated in the bid and must be received at least ten (10) days prior to the date fixed for the opening of bids. All such interpretations and any supplemental instructions will be in the form of written addenda to the specifications and will be

distributed to all prospective bidders in accordance with N.J.S.A. 40A:11-23. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the contract documents.

## **7. MISCELLANEOUS**

- 7.1** At the time of the opening of bids, each bidder will be presumed to have read and to be thoroughly familiar with the specifications and all other bid documents (including addenda). The failure or omission of any bidder to receive or examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect to his bid.
- 7.2** In case of default by the successful bidder, the County of Camden may procure the articles or services from other sources and hold the successful bidder responsible for any excess cost occasioned thereby.
- 7.3** County of Camden is exempt from any State sales tax and Federal excise tax. In submitting this bid, the bidder certifies that its total bid price does not include any such taxes.
- 7.4** For purposes of evaluation where an equivalent is being furnished, the bidder must indicate any variation to the County's specifications no matter how slight. If no variations are indicated, it will be construed that the bid fully and exactly complies with the County's specifications.
- 7.5** All bids submitted shall include in price any applicable permits, or fees required by any other government entity that has jurisdiction to require the same.
- 7.6** In submitting its bid, the bidder certifies that the merchandise to be furnished will not infringe upon any valid patent or trademark and that the successful bidder shall, at its own expense, defend all actions or suits charging such infringement, and will save the County harmless from any damages resulting from such infringement.
- 7.7** The bidder understands and agrees that, if awarded any contract by the County of Camden, it shall be responsible for insuring that it and all subcontractors meet minimum safety, health and equipment requirements including provisions for protecting employees and the public from any hazards encountered in performing its obligations pursuant to this bid.
- 7.8** All Firms are advised that, pursuant to N.J.S.A. 19:44A-20.27, it is their responsibility to file an annual disclosure statement with the New Jersey Election Law Enforcement Commission ("ELEC") if, during the calendar year, they receive a contract(s) in excess of \$50,000 from public entities, including Camden County. It is the firm's responsibility to determine if such filing is necessary. Additional information on this requirement is available from ELEC at 888-313-3532.

## **8. SECURITY FOR FAITHFUL PERFORMANCE**

- 8.1** Simultaneously with its delivery of the executed contract, the successful bidder shall deliver to the County an executed bond in the amount of one hundred percent (100%) of the accepted bid as security for the faithful performance of this contract and for the

payment of all persons performing labor or furnishing materials in connection therewith, prepared in the form of contract bond attached hereto and having a surety thereon such surety company or companies as are acceptable on bonds approved by the County, and as are authorized to transact business in this State.

- 8.2** In the event the successful bidder chooses to supply a Letter of Credit in lieu of the performance bond required by Section 8.1 above, said Letter of Credit shall be delivered to the County simultaneously with the delivery of the executed contract. The Letter of Credit shall be for the full amount of the bid and shall conform to the terms set forth in the terms of Letter of Credit in these specifications. **This Letter of Credit option is not available on construction projects exceeding \$100,000. Such projects require a Performance Bond. See N.J.S.A. 40A:11-22.**

## **9. INSURANCE REQUIREMENTS**

(Where applicable the following insurance requirements shall apply).

### **9.1 Workers Compensation and Employer's Liability Insurance**

This insurance shall be maintained in force during the life of the contract and shall cover all employees engaged in the performance of the contract. This insurance shall comply with all applicable statutes and regulations. Minimum Employer's Liability insurance of \$500,000.00.

### **9.2 General Liability Insurance**

This insurance shall have limits of not less than \$1,000,000.00 per occurrence and \$3,000,000.00 aggregate for bodily injury and property damage and shall be maintained in force during the life of the contract.

### **9.3 Builders Risk Insurance where applicable**

This insurance shall cover all building construction, reconstruction, alteration, or related work and shall have limits of not less than the agreed completed value of the project. The coverage shall be written on a replacement cost basis and a copy of such policy shall be provided to the County before construction commences. Coverage shall remain in force until a certificate of occupancy has been issued.

### **9.4 Automobile Liability Insurance**

This insurance shall cover the Contractor for claims arising from owned, hired and non-owned vehicles and shall have limits of not less than \$1,000,000.00 per occurrence for bodily injury and property damage. Coverage shall be maintained in force during the life of the contract.

### **9.5 Insurance Requirements for Subcontractors**

On any construction, reconstruction, alteration, or similar project, the Contractor shall require each Subcontractor to carry insurance coverage equal to or exceeding the type and level of coverage required to be carried by the Contractor. This coverage shall be in addition to the coverage carried by the Contractor.

## 9.6 Certificates of the Required Insurance

Certificates for the above listed insurance shall be submitted along with the signed contract as evidence that such insurance is in force and shall name the **County of Camden as additional insured**. The notice to proceed and/or purchase order will not be issued by the County until the certificate of insurance is provided with the signed contract. Such coverage shall be with acceptable insurance companies operating on an admitted basis in the State of New Jersey.

## 9.7 Cancellation

Certificates for the above-listed insurance shall contain a provision that coverage afforded under the policies will not be cancelled without at least thirty (30) days prior written notice to the County of Camden.

## 10. INDEMNIFICATION

**10.1** The contractor shall assume all risk of and responsibility for, and agrees to indemnify, defend, and save harmless the County of Camden and its officials and employees from and against any and all claims, demands, suits, actions, recoveries, judgments and costs and expenses in connection therewith on account of the loss of life, property or injury or damage to the person, body or property of any person or persons whatsoever, which shall arise from or result directly or indirectly from the work and/or materials supplied under this contract. This indemnification obligation is not limited by but is in addition to the insurance obligations contained in this agreement.

## 11. AWARD

**11.1** Award of contract will be made by the Camden County Board of Commissioners within sixty (60) days after the bid opening or within the time allowed by law.

**11.2** Upon award of the contract, appropriate documents shall be forwarded to the successful bidder. N.J.S.A. 40A:11-24(b) requires the contract to be signed by all parties within the time set forth in the specifications, which shall not exceed twenty-one (21) days, Sundays and holidays excepted, after the making of the award. At the expiration of such time, the County may elect to award the bid to the next lowest responsible bidder and accept as liquidated damages the bid security.

## 12. QUANTITIES

**12.1** Quantities shown are approximate and the Board reserves the right to increase or decrease them to the extent of twenty percent (20%) at the unit price bid. If the number of units in the total is less than ten (10), the County shall have the right to increase or decrease the quantity to not more than ten (10) or less than one at same unit price. Such change, however, will only be upon the written order of the County.

## 13. PREVAILING WAGE ACT / CERTIFIED PAYROLL SUBMISSIONS

**13.1** Pursuant to N.J.S.A. 34:11-56.25 et seq., P.L. 2009, c.249, and as amended, successful bidders on projects for public work shall adhere to all requirements of the New Jersey Prevailing Wage Act.

13.2 The contractor on any public works project for the County shall be required to submit a certified payroll record to the County Department administering said public works project. DO NOT SEND TO PURCHASING DEPARTMENT. Such certified payroll record must be submitted within ten (10) days of the payment of the wages. The contractor is also responsible for obtaining and submitting all subcontractors' certified payroll records within the aforementioned time period. The contractor shall submit said certified payrolls in the form set forth in N.J.A.C. 12:60 Appendix A. It will be the contractor's responsibility to obtain any additional copies of the certified payroll form to be submitted by contacting the Office of Administrative Law, CN 049, Trenton, New Jersey 08625 or the New Jersey Department of Labor, Division of Workplace Standards.

#### 14. METHOD OF AWARD

14.1 For goods and services contracts the County may award the work based on the lowest responsible Base Bid or may elect to award the work based on the line items or unit prices, whichever is in the best interest of the County.

14.2 For construction contracts, the County will award the contract to the lowest responsible bidder whose base bid is the lowest.

14.3 If Alternates are provided for in the bid and the County determines it has sufficient funds to award some or all the Alternates, the lowest responsible Base Bid combined with such Alternates as selected will be awarded until a net amount is reached which is within the funds available. Alternate(s) may also be deferred and awarded at a later date in the sole discretion of the County. **The cost of any Alternate(s) included in the bid shall be awarded consistent with New Jersey law.**

#### 15. TERM OF CONTRACT

15.1 The term of the contract to be awarded as the result of this bid shall be for one (1) year from the date of execution of the agreement unless otherwise stated.

#### 16. TERMINATION

16.1 The County may terminate the agreement for any reason upon thirty (30) days written notice to the contractor. The County shall only be responsible for payment up to the effective date of termination.

#### 17. AMERICAN GOODS AND PRODUCTS TO BE USED WHERE AVAILABLE

17.1 Pursuant to N.J.S.A. 40A:11-18, only manufactured and farm products of the United States wherever available, shall be used in the execution of the work or supply of goods as specified herein.

#### 18. AVAILABILITY OF FUNDS

18.1 Pursuant to N.J.S.A. 40A:11-15 any contract resulting from this bid shall be subject to the availability and appropriation of sufficient funds annually.

## 19. PURCHASING FROM STATE CONTRACT

- 19.1 The County reserves the right to purchase, during the term of any contract to be awarded, any of the specified materials and/or services through the New Jersey State Cooperative Purchasing Agreement (State Contract) if it is in the County's best interest to do so.

## 20. BRAND NAMES AND/OR PRODUCT DESCRIPTION

- 20.1 Pursuant to N.J.S.A. 40A:11-13, brand names and/or descriptions used in this specification for bid proposal are to acquaint prospective bidders with the type of equipment (or commodity) described and will be used as a standard by which alternate or competitive materials offered will be judged. Competitive items must be equal to the standard described and be of the same reputation for quality and workmanship. Variations between the equipment described and material offered are to be fully explained by the bidder in an accompanying letter. In the absence of any changes by the bidder, it will be presumed and required that materials as described in these specifications be delivered.

It is recognized that no two pieces of equipment and no two products are engineered or designed the same. Trade names, brand names and models specified herein are provided to establish a minimum standard of quality acceptable to the County for this bid. Substitute brands, makes and models shall be considered and reviewed based on its ability to perform the specified tasks or provide the same quality of goods as specified in the County's bid. This is known as an "Equivalent".

If the bidder seeks to provide an Equivalent product or good, the bidder shall with its bid, submit specifications or cut sheets for such proposed Equivalent product or good. The County's Architect/Engineer, or specifications writer, for the bid shall review the submission provided by the bidder to determine whether the product or good is an Equivalent to the bid specification. The County's Architect/Engineer or specifications writer shall have the final decision on whether a bidder's submitted product specifications are an Equivalent to the named product(s) or good(s) in the bid.

## 21. WORKER AND COMMUNITY RIGHT TO KNOW

- 21.1 The successful bidder shall comply with all provisions of the Worker and Community Right to Know Act, N.J.S.A. 34:5A-1 et seq., as well as the regulations under the Act (N.J.A.C. 8:59-1.1 et seq.).

## 22. COOPERATIVE PRICING

- 22.1 If this bid is being issued under the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, then each bidder must read the **Rules and Instructions for Bids Under the Camden County Cooperative Pricing System** attached hereto and indicate on **Exhibit L** whether its bid proposal is extended or not extended to registered system members (other agencies) by checking the appropriate box.

**IMPORTANT NOTICE: A bidder's failure to complete Exhibit L in the case of a bid for the Camden County Cooperative Pricing System shall be deemed to be an extension of prices by that bidder to registered system members (other agencies).**



## **23. BIDS FOR THE PURCHASE OF TEXTILES AND ITEMS OF APPAREL**

In accordance with Resolution No. 55 of the Camden County Board of Commissioners adopted on May 21, 1998, the following terms and conditions shall apply to all bids for the purchase of textiles and/or items of apparel:

### **23.1 Disclosure of all subcontractors and sites**

Each bidder shall set forth in **Exhibit M** of its bid response the name and address of each subcontractor to be used in the provision of the goods or services which are the subject of this bid. Additionally, each bidder shall set forth in **Exhibit M** of its bid the name and address of all locations, including subcontractor locations, substantially involved in the production of the goods or services which are the subject of this bid. Such information shall be considered public information.

### **23.2 Certification of Compliance.**

Bidders shall certify in **Exhibit M** that each location, including subcontractor locations, substantially involved in producing or distributing such goods meet the following standards:

**a. Compensation.** Wage and benefit levels must be sufficient to meet basic needs and provide some discretionary income for a family of 4 (a "living wage"). For employment within the United States, this shall mean wages of at least \$7 per hour in 1997 dollars, along with affordable family health benefits and company-paid pension benefits typical of responsible employers.

**b. Rights.** The company respects workers' rights to speak up about working conditions without fear of retaliation, and to form unions of their own choosing without employer resistance. Due process and just cause procedures are used for discipline or discharge. The company complies with all laws, regulations, and ILO standards governing the workplace. The company does not use child labor, forced labor, or corporal punishment. The company does not discriminate in hiring, promotion or compensation based on race, national origin, religion, gender, sexual preference, union affiliation, or political affiliation.

**c. Safety and Health.** The company provides a safe and healthy work environment.

### **23.3 Correction and remediation of violations; Proof of compliance**

The County may, at its discretion, require correction and remediation of violations of the standards listed above prior to renewing commerce with the contractor. The County may require further proof of compliance with the aforementioned standards. Upon the County's request, the contractor or subcontractor shall make all relevant records available to the County or its designee.

## **24. COMPLIANCE WITH PUBLIC WORKS CONTRACTOR REGISTRATION ACT**

The bidder shall comply with The Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq. on all bids for public works as defined in the law. Proof of compliance with this law, when applicable, must be submitted prior to award of contract. The bidder and its named specialty trade subcontractor(s) listed in Exhibit N (see below), shall provide proof of compliance prior to award of contract or bid will be rejected as non-compliant. Questions regarding this law may be directed to the New

Jersey Department of Labor and Workforce Development, Contractor Registration Unit at 609-292-9464. **The County strongly recommends that each bidder provide its public works contractor registration certificate (and certificates for each Exhibit N subcontractor) with submission of bids.**

## **25. REQUEST FOR TAXPAYER IDENTIFICATION NUMBER AND CERTIFICATION**

Upon execution of the contract with the County, the successful bidder shall be required to complete and submit IRS Form W-9, Request For Taxpayer Identification Number And Certification to the County's Division of Accounts Payable, 520 Market Street, 6th Floor, Camden, New Jersey 08102. This requirement shall only apply to the successful bidder. Failure by the successful bidder to meet this requirement shall result in the County withholding such funds as required by IRS regulations.

## **26. BIDS FOR CONSTRUCTION/DISCLOSURE OF SUBCONTRACTORS**

### **26.1 Definition of Construction Bid.**

"Construction" means construction, alteration or repair of any public building when the entire cost of the work will exceed the bid threshold. In addition to construction bids, the County specifically requires that bidders identify all subcontractors in specialty trade categories for all bids where such specialty trades may be required (see below and Section 35).

### **26.2 Disclosure of Subcontractors.**

a. Bidders must list in **Exhibit N**, all subcontractors in the specialty trade categories of: Plumbing and Gas Fitting, and All Kindred Work; Steam Power Plants, Steam and Hot Water Heating and Ventilating Apparatus, and All Kindred Work; Electrical Work; and Structural Steel and Ornamental Iron Work, as required by N.J.S.A. 40A:11-16. **FAILURE TO LIST THESE REQUIRED SUBCONTRACTORS SHALL BE CAUSE FOR REJECTION OF BID.**

Bidders with questions regarding this process should consult their counsel.

b. Substitution of subcontractors shall be permitted only in cases of impossibility, e.g., the death of the subcontractor or where the subcontractor goes out of business.

c. The bidder's proposal will be rejected if the subcontractors listed do not comply with the requirements for the designated work tasks.

d. A general contractor that intends to utilize a specific subcontractor to perform work in one or more of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16 (See **Exhibit N**), shall provide the required information about that subcontractor in the appropriate spaces for each specialty trade category applicable to the contract.

A general contractor that intends to perform work in one or more of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16 (See **Exhibit N**) through the use of its own employees or the general contractor himself rather than through utilization of a subcontractor shall write the word "In-House" next to each applicable category and then insert the name, and the license number where required, of each such employee of the general contractor or the general contractor himself in the appropriate spaces for each specialty trade category applicable to the contract.

If the contract does not involve any of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16, the contractor shall insert the word “None” in each appropriate space provided.

e. If the bidder proposes to perform **plumbing, gas fitting and all kindred work** with its own personnel, it shall follow the requirements of N.J.S.A. 45:14C-1 et seq. and N.J.A.C. 13:32-1.1 et seq.

f. If the bidder proposes to perform **electrical work** with its own personnel, it shall follow the requirements of N.J.S.A. 45:5A-1 et seq. and N.J.A.C. 13:31-1.1 et seq.

**27. RESERVED**

**28. NO DAMAGES FOR DELAY**

Extension of the contract time shall be the sole remedy of the Contractor for any: (1) delay in the commencement, prosecution or completion of the work; (2) hindrance or obstruction in the performance of the work; (3) loss of productivity; or (4) other similar claims whether or not such delays are foreseeable, unless such delay is due to the County’s negligence, bad faith, active interference, tortious conduct or other reasons unanticipated by the parties that delay the contractor’s performance, in accordance with the provisions of N.J.S.A. 40A:11-16.7. The aforementioned shall apply to any contract awarded as the result of this bid including but not limited to contracts for construction, goods, or services.

**29. ALTERNATIVE DISPUTE RESOLUTION**

For construction contracts, as defined in N.J.S.A. 40A:11-50, disputes arising under the contract shall be submitted to mediation or non-binding arbitration pursuant to industry standards prior to being submitted to a court for adjudication.

**30. COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT**

The successful bidder shall comply with the mandatory language of the Americans With Disabilities Act as set forth in **Exhibit P** attached hereto.

**31. COMPLIANCE WITH CONTRACTOR BUSINESS REGISTRATION PROGRAM**

Pursuant to N.J.S.A. 52:32-44, Camden County is prohibited from entering in a contract with an entity unless the bidder/proposer/contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of the Treasury.

Prior to contract award or authorization, the contractor shall provide the Contracting Agency with its proof of business registration and that of any named subcontractor(s).

Subcontractors named in a bid or proposal shall provide proof of business registration to the bidder, who in turn, shall provide it to the Contracting Agency prior to the time of contract, purchase order, or other contracting document is awarded or authorized.

During the course of contract performance:

- (1) The contractor shall not enter in a contract with a subcontractor unless the subcontractor first provides the contractor with a valid proof of business registration.
- (2) The contractor shall maintain and submit to the Contracting Agency a list of subcontractors and their addresses that may be updated from time to time.
- (3) The contractor and any subcontractor providing goods or performing services under the contract, and each of their affiliates, shall collect and remit to the Director of the Division of Taxation in the Department of Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et seq.) on all sales of tangible personal property delivered in the State. Any questions in this regard can be directed to the Division of Taxation at (609) 292- 6400. Form NJ-REG can be filed online at [www.state.nj.us/treasury/revenue/busregcert.shtml](http://www.state.nj.us/treasury/revenue/busregcert.shtml).

Before final payment is made under the contract, the contractor shall submit to the Contracting Agency a complete and accurate list of all subcontractors used and their addresses.

Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of \$25 for each day of violation, not to exceed \$50,000, for each proof of business registration not properly provided under a contract with a contracting agency.

**The County strongly recommends that each bidder provide its BRC (and BRC's for each subcontractor) with submission of bids.**

STATE OF NEW JERSEY BUSINESS REGISTRATION CERTIFICATE FOR STATE AGENCY AND CASINO SERVICE CONTRACTORS		DEPARTMENT OF TREASURY DIVISION OF REVENUE PO BOX 252 TRENTON, N.J. 08644-0252
TAXPAYER NAME: <b>TAX REGISTRATION TEST ACCOUNT</b>	TRADE NAME: <b>CLIENT REGISTRATION</b>	
TAXPAYER IDENTIFICATION#: <b>970-097-382/500</b>	SEQUENCE NUMBER: <b>0107330</b>	
ADDRESS: <b>847 ROEBLING AVE TRENTON NJ 08611</b>	ISSUANCE DATE: <b>07/14/04</b>	
EFFECTIVE DATE: <b>01/01/01</b>	<i>John S. Tully</i> Acting Director	
FORM-BRC(08-01)	This Certificate is NOT assignable or transferable. It must be conspicuously displayed at above address.	

STATE OF NEW JERSEY BUSINESS REGISTRATION CERTIFICATE	
<b>Taxpayer Name:</b>	TAX REG TEST ACCOUNT
<b>Trade Name:</b>	
<b>Address:</b>	847 ROEBLING AVE TRENTON, NJ 08611
<b>Certificate Number:</b>	1093907
<b>Date of Issuance:</b>	October 14, 2004
<b>For Office Use Only:</b>	
	20041014112823533

**32. ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA**

The bidder shall complete, sign and return with bid **Exhibit Q** attached hereto. Form must be completed and returned with bid regardless of whether addenda were issued by the County.

**33. UNIFORMED LAW ENFORCEMENT OFFICERS REQUIREMENT FORM**

Pursuant to N.J.S.A. 40A:11-23.1(c) if uniformed law enforcement officers are required for the project, **Exhibit R** will be completed by the County and indicate a good faith estimate of the total cost of traffic control personnel, vehicles, equipment, administrative, or any other costs associated with additional traffic control requirements as determined by the County with input from any other public entity affected by the project. These estimated amounts reflect those costs above and beyond the bidder's traffic control costs.

**34. APPROVAL AND CERTIFICATION OF BILLING**

Authorization for payment of periodic billing, final payments or retainage monies requires approval and certification by formal resolution of the Camden County Board of Commissioners. Pursuant to N.J.S.A. 40A:11-19.1, unless otherwise provided for in the contract, the required payment date shall be 60 calendar days from the receipt of a properly executed invoice, or 60 calendar days from the receipt of goods or services, whichever is later. Interest shall not be paid unless goods and services are rendered. Interest on amounts due shall be paid for the period beginning on the day after the required payment date and ending on the date on which the check for payment is drawn. Interest shall be paid at the rate specified by the State Treasurer for State late payments.

**35. PROPRIETARY GOODS**

       County to Check if applicable

If checked off above, the goods set forth in the technical specifications have been certified as proprietary goods in accordance with the Local Public Contracts Law, N.J.S.A. 40A:11-1 et seq. No substitutions or equivalents will be accepted. Please see the technical specifications attached hereto.

**36. CONTRACTS WHERE ASPHALT WORK IS INCLUDED IN SPECIFICATIONS**

N.J.S.A. 40A:11-13(g) and P.L. 2015, c.201 requires the inclusion of a pay item for an asphalt price adjustment for any bid specification that includes the purchase or use of hot mix asphalt; provides for application of a fuel price adjustment where a pay item is eligible (see NJDOT Section 160.03.01, where applicable); for contracts issued for more than 1,000 tons, requires the price adjustment pay item be applied to each ton of hot mix asphalt purchased and used, not just the tonnage exceeding the 1,000 ton threshold; clarifies that the term “hot mix asphalt” includes equivalent asphalt cement-based products (e.g. warm mix asphalt); prohibits disaggregation of quantities to avoid compliance with P.L. 2015, c.201.

**37.** Pursuant to N.J.S.A. 40A:11-16.6, all construction contracts issued by the County when the total price of the originally awarded contract equals or exceed \$5,000,000.00, shall allow for value engineering construction change orders to be approved after the award of the contract.

**38. PERMISSION FOR BIDDER TO WITHDRAW A PUBLIC WORKS BID DUE TO A MISTAKE IN CERTAIN CIRCUMSTANCES**

Effective March 4, 2011, N.J.S.A. 40A:11-23.3 authorizes a bidder to request withdrawal of a **public works bid** due to a mistake on the part of the bidder. A mistake is defined by N.J.S.A. 40A:11-2(42) as a clerical error that is an **unintentional and substantial computational error or an unintentional omission of a substantial quantity of labor, material, or both, from the final bid computation.**

A bidder claiming a mistake under N.J.S.A. 40A:11-23.3 must submit a request for withdrawal, **in writing**, by certified or registered mail to the Camden County Purchasing Agent, 520 Market Street, 6<sup>th</sup> Floor, Camden, New Jersey, 08102. Written requests must be provided within five business days after the receipt and opening of the bids. The bid withdrawal shall be effective as of the postmark of the certified or registered mailing.

A bidder’s request to withdraw the bid shall contain evidence, including any pertinent documents, demonstrating that a mistake was made. Such documents and relevant written

information **shall** be reviewed and evaluated by the public owner's designated staff pursuant to the statutory criteria of N.J.S.A. 40A:11-23.3.

The County will not consider any written request for a bid withdrawal for a mistake as defined by N.J.S.A. 40A:11-2(42), by a bidder in the preparation of a bid proposal unless the postmark of the certified or registered mailing is within five business days following the opening of bids.

If a bidder is granted a bid withdrawal, the bidder shall be disqualified from future bidding on the same project, including whenever all bids are rejected pursuant to N.J.S.A. 40A:11-13.2

**39. N.J.A.C. § 17:44-2.2 AUTHORITY TO AUDIT OR REVIEW CONTRACT RECORDS**

(a) Relevant records of private vendors or other persons entering into contracts with covered entities are subject to audit or review by OSC pursuant to N.J.S.A. 52:15C-14(d).

(b) The contract partner shall maintain all documentation related to products, transactions or services under this contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request."

**40. NEW JERSEY ANTI-DISCRIMINATION PROVISIONS: N.J.S.A. 10:2-1 et seq.**

If awarded a contract, the contractor agrees to abide by the New Jersey anti-discrimination provisions contained in N.J.S.A. 10:2-1 et seq. See Exhibit U.

**41. CHANGED CONDITIONS**

Please see Exhibit V: N.J.S.A. 40A:11-16.7, Changed conditions contract provisions; inclusion in certain construction contracts.

**END OF INSTRUCTIONS TO BIDDERS / EXHIBITS BEGIN ON NEXT PAGE**

**EXHIBIT A**  
**BID BOND**

A. We, the undersigned

\_\_\_\_\_ as Principal and  
\_\_\_\_\_ as Surety, are hereby held and firmly bound unto  
\_\_\_\_\_ in the penal sum of \_\_\_\_\_ Dollars

(\$ \_\_\_\_\_), lawful money of the United States for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns. Signed this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

B. THE CONDITION of the above obligation is such that whereas the Principal has submitted to the \_\_\_\_\_,  
a certain bid attached hereto and hereby made a part of hereto and hereby made a part of hereof, to enter into a contract in writing for the (insert type of work)  
\_\_\_\_\_.

C. **NOW THEREFORE:**

If said bid shall be rejected, or in the alternate, if said bid shall be accepted and the Principal shall execute and deliver a contract in the form of Agreement required by the Bid Documents and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all respects perform the agreement created by the acceptance of said bid. Then this obligation shall be void, otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

D. THE SURETY for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall in no way be impaired or affected by an extension of the time within the "OBLIGEE" may accept such bid. And said Surety does hereby waive notice of any such extension.

E. IN WITNESS, WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as corporations have caused their corporate seals to be hereto fixed and these presents to be signed by their proper officers, the day and year set forth above.

\_\_\_\_\_(L.S.)  
PRINCIPAL

\_\_\_\_\_  
SURETY

(SEAL)

\_\_\_\_\_  
BY

**NOTE: Bid Bond must be signed by an authorized agent or representative of a surety company and not by the individual or company submitting the bid.**



**EXHIBIT B**

**CONSENT OF SURETY**

BOND NO. \_\_\_\_\_  
(INSERT YOUR BOND NO. HERE)

The \_\_\_\_\_, a Corporation organized and  
(NAME OF YOUR INSURANCE COMPANY)

existing under the laws of the State of \_\_\_\_\_,

and licensed to do business in the State of New Jersey, hereby consents and agrees that if the

contract for: \_\_\_\_\_ (INSERT BID NO.)

\_\_\_\_\_ AND ITEMS  
WHICH YOU ARE BIDDING).

be awarded to \_\_\_\_\_.  
(NAME OF YOUR COMPANY)

the undersigned Corporation agrees with the said County of Camden, Courthouse, 520 Market Street, Camden, New Jersey 08102 to execute the final bond as required by the specifications and to become the surety in the full amount of the price bid for the faithful performance of the contract.

In Witness, Whereof, the undersigned Corporation has caused this agreement to be signed by its duly authorized representative and its Corporate Seal to be hereto affixed this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

The \_\_\_\_\_  
(NAME OF INSURANCE COMPANY)

By \_\_\_\_\_  
(ATTORNEY-IN-FACT)

Countersigned by:

**NOTE:** Consent of Surety must be signed by an authorized agent or representative of a surety company and not by the individual or company submitting the bid.

**EXHIBIT C**

**FORM OF PERFORMANCE BOND**  
(to be executed by the successful bidder)

We, the Undersigned

\_\_\_\_\_

as Principal, and \_\_\_\_\_

\_\_\_\_\_

a Corporation organized and existing under the laws of the State of \_\_\_\_\_ and authorized to do business in the State of New Jersey as surety are held and firmly bound unto \_\_\_\_\_ hereinafter called the Owner as hereinafter set forth, in the full and just several sums of

(a) \_\_\_\_\_

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

for faithful performance of the contract as hereinafter designated in Paragraph "A" and

(b) \_\_\_\_\_

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

for payment of labor and material as hereinafter designated in Paragraph "B" and

(c) \_\_\_\_\_

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

for maintenance as hereinafter designated in Paragraph "C"; lawful money of the United States of America; to be paid to the Owner, or its Assigns, to which payment well and truly to be made and done, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

Sealed with our respective seals and dated this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

WHEREAS, the above bonded Principal has entered into a contract with the Owner dated the \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ for \_\_\_\_\_

\_\_\_\_\_

upon certain terms and conditions in said contract more particularly mentioned; and

WHEREAS, it is one of the conditions of the award of the Owner pursuant to which said contract is about to be entered into, that these presents be executed.

**(Form of Performance Bond – continued)**

**NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH:**

**A.** That if the Principal shall faithfully perform the contract on its part to be performed according to the terms of said contract, or any changes or modifications therein made as therein provided; and shall indemnify and save harmless the party of the first part mentioned in the contract aforesaid, its officers, agents and servants, and each and every one of them against and from all suits and costs of every kind and description and from all damages which the said party of the first part in said contract mentioned, or any of its officers, agents or servants may be put by reason of injury to the person or property of others resulting from the performance of said work or through the negligence of the said party of the second part to said contract, or through any improper or defective machinery, implements or appliances used by the said party of the second part in the aforesaid work or through any act or omission on the part of the said party of the second part of its agents, servants or employees, and shall further indemnify and save harmless the party of the first part mentioned in the contract aforesaid its officers, agents and servants from all suits and actions of any kind or character whatsoever, which may be brought or instituted by any subcontractor, materialman or laborer who has performed work or furnished materials in or about the work required to be done pursuant to the said contract or by or on account of, any claims or amount recovered for any infringement of patent, trademark, or copyright; then this part of this obligation designated as part "A" shall be void; otherwise the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

**B.** That if the said Principal shall pay all lawful claims of subcontractors, materialmen, laborers, persons, firms or corporations for labor performed or materials, provisions, provender or other supplies or items, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, materialman, laborer, person, firm or corporation having a just claim, as well as for the obligee herein; whether or not the said material and labor enter into and become component parts of the work or improvement or in any amendment, extension or addition to said contract, then this part of this obligation designated part "B", shall be void, otherwise the same shall remain in full force and effect.

**C.** That if the said Principal shall well and truly keep and perform all the obligations, agreements, terms, and conditions of such contract, on the Principal's part to be kept and performed and said Principal shall be responsible for poor workmanship done or poor materials furnished under said contract for a period of one year from the date of the completion and final acceptance by the party of the first part and mentioned in the contract, and said Principal shall pay for all labor performed and furnished and for all materials used in correcting any poor workmanship done and replacing any poor materials furnished, then this part of this obligation designated part "C", shall be void; otherwise the same shall remain in full force and effect.

It is further agreed that any alterations which may be made in the terms of the contract or in the work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the Owner of any extension of time for the performance of the Contract or the reduction of the retained percentages as permitted by the Contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety or Sureties or either or any of them, their heirs, executors, administrators, successors or assigns, from their liability hereunder, notice to the Surety or Sureties of any alterations, extension or forbearance being hereby waived.

**(Form of Performance Bond – continued)**

It is further agreed that in case of default in, and/or any action arising out of rights and liabilities secured by this obligation or any part hereto or any person claiming by or through it, either may use for the purpose of establishing its, or their claim, a copy of this obligation certified by the Owner, and the action, or actions, if any, arising on the within bond, shall not be a bar to any subsequent action that may arise through any liability incurred in any other action herein and based upon any other part of this obligation.

IN WITNESS, WHEREOF, the said Principal and Surety have duly executed this bond under their seals the day and year above written.

If Principal is an individual:

Witness:

\_\_\_\_\_

By \_\_\_\_\_(SEAL)

\_\_\_\_\_

Surety

\_\_\_\_\_

By \_\_\_\_\_

Attorney-in-fact  
(Corporate Seal)

If Principal is a partnership:

Witness:

\_\_\_\_\_

Principal

\_\_\_\_\_

\_\_\_\_\_ (SEAL)

Partner

\_\_\_\_\_

\_\_\_\_\_ (SEAL)

Partner

\_\_\_\_\_

Surety

By \_\_\_\_\_

Attorney-in-fact  
(Corporate Seal)

(Form of Performance Bond – continued)

If Principal is a corporation:

Attest:

\_\_\_\_\_  
Secretary

Corporate Seal:

Attest:

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Principal

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

\_\_\_\_\_  
By \_\_\_\_\_  
Attorney-in-fact  
(Corporate Seal)

Approved as to Form \_\_\_\_\_, 20\_\_\_\_

\_\_\_\_\_  
Assistant County Counsel

**EXHIBIT D**

**SAMPLE FORM OF TERMS OF LETTER OF CREDIT**

1. **AMOUNT:** The amount of this letter of credit shall be for the sum of \_\_\_\_\_.  
(Amount of Contract)

2. **TERM:** The term of this letter of credit shall be in effect and irrevocable for a period commencing on the date of execution of the agreement between the County of Camden and\_\_\_\_  
(Name of Contractor)

and terminating one (1) year after the date of completion and final acceptance by the County of the work performed pursuant to Camden County Bid No.:

\_\_\_\_\_  
(Bid No. and description of services/material to be provided)

3. **CAUSES FOR PROCEEDING AGAINST LETTER OF CREDIT:** The County shall have the absolute right to proceed against this letter of credit if:

(a) Contractor shall fail to faithfully perform according to the terms of the contract and Camden County Bid No.\_\_\_\_\_, or any changes or modifications therein made as therein provided; or Contractor shall fail to indemnify and save harmless the County of Camden, its officers, agents and servants, and each and every one of them against and from all suits and costs of every kind and description and from all damages which the County, or any of its officers, agents or servants may be put by reason of injury to the person or property of others resulting from the performance of said work or through the negligence of Contractor, or through any improper or defective machinery, implements or appliances used by contractor in the aforesaid work or through any act or omission on the part of Contractor, its agents, servants or employees; or contractor shall fail to further indemnify and save harmless the County, its officers, agents and servants from all suits and actions of any kind or character whatsoever, which may be brought or instituted by any subcontractors, materialman or laborer who has performed work or furnished materials in or about the work required to be done pursuant to said contract, or by or on account of, any claims or amount recovered for any infringement of patent, trademark, or copyright; or \_\_\_\_\_

(Name of Bank)

agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, materialman, laborer, person, firm or corporation having a just claim, as well as for the County of Camden, whether or not the said material and labor enter into and become component parts of the work or improvement or in any amendment, extension or addition to said contract; or

(b) Contractor shall fail to pay all lawful sums of subcontractors, materialman, laborers, persons, firms or corporations for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing of said contract; or

(c) Contractor shall fail to well and truly keep and perform all the obligations, agreements, terms and conditions of such contract, on its part to be kept and performed and Contractor shall be responsible for poor workmanship done or poor materials furnished under said contract for a period of one (1) year from the date of the completion and final acceptance by the County of Camden, and Contractor shall pay for all labor performed and furnished and for all materials used in correcting any poor workmanship done and replacing any poor materials furnished.

It is further agreed that any alterations which may be made in the terms of the contract or in the work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the County of Camden of any extension of time for the performance of the contract shall not in any way release Contractor, its heirs, executors, administrators, successors or assigns, from its liability hereunder.

**NOTE: Letter of Credit must be signed by an authorized agent or representative of a bank or similar financial institution and not by the individual or company submitting the bid.**

**EXHIBIT E**  
**STATEMENT OF OWNERSHIP DISCLOSURE**

N.J.S.A. 52:25-24.2 (P.L. 1977, c.33, as amended by P.L. 2016, c.43)

**This statement shall be completed, certified to, and included with all Bid and Competitive Contracting RFP submissions. Failure to submit the required information is cause for automatic rejection of the bid or proposal.**

**Name of Organization:** \_\_\_\_\_

**Organization Address:** \_\_\_\_\_

**Part I**      **Check the box that represents the type of business organization:**

- Sole Proprietorship (skip Parts II and III, execute certification in Part IV)
- Non-Profit Corporation (skip Parts II and III, execute certification in Part IV)
- For-Profit Corporation (any type)                       Limited Liability Company (LLC)
- Partnership                       Limited Partnership                       Limited Liability Partnership (LLP)
- Other (be specific): \_\_\_\_\_

**Part II**

- The list below contains the names and addresses of all individual stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein. **(COMPLETE THE LIST BELOW IN THIS SECTION)**

**OR**

- No one stockholder in the corporation owns 10 percent or more of its stock, of any class, or no individual partner in the partnership owns a 10 percent or greater interest therein, or no member in the limited liability company owns a 10 percent or greater interest therein. **(SKIP TO PART IV)**

(Please attach additional sheets if more space is needed):

Name of Individual or Business Entity	Address



**Part III DISCLOSURE OF 10% OR GREATER OWNERSHIP IN THE STOCKHOLDERS, PARTNERS OR LLC MEMBERS LISTED IN PART II**

If a bidder has a direct or indirect parent entity which is publicly traded, and any person holds a 10 percent or greater beneficial interest in the publicly traded parent entity as of the last annual federal Security and Exchange Commission (SEC) or foreign equivalent filing, ownership disclosure can be met by providing links to the website(s) containing the last annual filing(s) with the federal Securities and Exchange Commission (or foreign equivalent) that contain the name and address of each person holding a 10% or greater beneficial interest in the publicly traded parent entity, along with the relevant page numbers of the filing(s) that contain the information on each such person. **Attach additional sheets if more space is needed.**

Website (URL) containing the last annual SEC (or foreign equivalent) filing	Page #'s

Please list the names and addresses of each stockholder, partner or member owning a 10 percent or greater interest in any corresponding corporation, partnership and/or limited liability company (LLC) listed in Part II other than for any publicly traded parent entities referenced above. The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner, and member exceeding the 10 percent ownership criteria established pursuant to N.J.S.A. 52:25-24.2 has been listed. **Attach additional sheets if more space is needed.**

Stockholder/Partner/Member and Corresponding Entity Listed in Part II	Address (for Individuals) Business Address (for Corporate Entity)

**Part IV Certification**

I, being duly sworn upon my oath, hereby represent that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I acknowledge: that I am authorized to execute this certification on behalf of the bidder/proposer; that **Camden County** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the completion of any contracts with **Camden County** to notify **Camden County** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with **Camden County** permitting **Camden County** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

**EXHIBIT F**

**NON-COLLUSION AFFIDAVIT**

STATE OF                    )  
COUNTY OF                )

I, \_\_\_\_\_ of the City of \_\_\_\_\_ in the County of \_\_\_\_\_ and the State of \_\_\_\_\_ of full age, being dully sworn according to law on my oath depose and say that: I am \_\_\_\_\_ of the firm of \_\_\_\_\_ the bidder making this Proposal for the above named project, and that I executed the said Proposal with full authority to do so; that said bidder had not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the State of New Jersey relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by \_\_\_\_\_ (N.J.S.A. 52:34-15)

(Name of Contractor)

Subscribed and sworn to  
before me this \_\_\_\_\_ day  
of \_\_\_\_\_, 20\_\_

\_\_\_\_\_  
Notary Public

\_\_\_\_\_  
(Also type or print name of bidder  
under signature)

**EXHIBIT G**

**MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE**  
**N.J.S.A. 10:5-31 et seq. (P.L. 1975, C. 127)**  
**N.J.A.C. 17:27**

**GOODS, PROFESSIONAL SERVICE AND GENERAL SERVICE CONTRACTS**

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union of the contractor's commitments under this chapter and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

The contractor or subcontractor agrees to make good faith efforts to meet targeted county employment goals established in accordance with N.J.A.C. 17:27-5.2.

The contractor or subcontractor agrees to inform in writing its appropriate recruitment agencies including, but not limited to, employment agencies, placement bureaus, colleges, universities, and labor unions, that it does not discriminate on the basis of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, and that it will discontinue the use of any recruitment agency which engages in direct or indirect discriminatory practices.

The contractor or subcontractor agrees to revise any of its testing procedures, if necessary, to assure that all personnel testing conforms with the principles of job-related testing, as established by

the statutes and court decisions of the State of New Jersey and as established by applicable Federal law and applicable Federal court decisions.

In conforming with the targeted employment goals, the contractor or subcontractor agrees to review all procedures relating to transfer, upgrading, downgrading and layoff to ensure that all such actions are taken without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, consistent with the statutes and court decisions of the State of New Jersey, and applicable Federal law and applicable Federal court decisions.

The contractor shall submit to the public agency, after notification of award but prior to execution of a goods and services contract, one of the following three documents:

1. Letter of Federal Affirmative Action Plan Approval
2. Certificate of Employee Information Report
3. Employee Information Report Form AA302 (electronically provided by the Division and distributed to the public agency through the Division's website at [www.state.nj.us/treasury/contract\\_compliance](http://www.state.nj.us/treasury/contract_compliance))

The contractor and its subcontractors shall furnish such reports or other documents to the Division of Purchase & Property, CCAU, EEO Monitoring Program as may be requested by the office from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Division of Public Contracts Equal Employment Opportunity Compliance for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

## **EXHIBIT H**

### **MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE N.J.S.A. 10:5-31 et seq. (P.L. 1975, C. 127) N.J.A.C. 17:27**

#### **CONSTRUCTION CONTRACTS**

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, up-grading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Division may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

- (1) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;
- (2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;
- (3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;
- (4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;
- (5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;
- (6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:
  - (i) The contractor or subcontractor shall interview the referred minority or women worker.
  - (ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The

contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA 201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.



**EXHIBIT I**

**QUESTIONNAIRE ON SUPPLY/SERVICE CONTRACTS**

Please complete this questionnaire and submit it with your bid. Any necessary forms will be sent to you by the County upon award.

1. Our Company has a Federal Affirmative Action Plan Approval.

YES \_\_\_\_\_ NO \_\_\_\_\_

A. If yes, submit a photostatic copy of said approval.

B. If no, submit a photostatic copy of the New Jersey Certificate of Employee Information Report.

NONE OF THE ABOVE \_\_\_\_\_

2. We have neither State nor Federal Affirmative Action evidence. Please send us Form AA-302 (Affirmative Action Employee Information Report application). (Check if applicable \_\_\_\_\_).

I certify that the above information is correct to the best of my knowledge.

NAME: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

**AN EQUAL OPPORTUNITY EMPLOYER**

**EXHIBIT J**

**AFFIRMATIVE ACTION PLAN MBE/WBE TRACKING FORM**

**Definitions:**

A **Minority Business Enterprise (MBE)** is defined in the Camden County Affirmative Action Plan as "a business which is independently owned and operated and is at least 51% owned and controlled by minority group members". Minority group members are defined in the Camden County Affirmative Action Plan as "persons who are Black, Hispanic, Portuguese, Asian-American, American Indian or Alaskan Natives"

A **Women Business (WBE)** is defined in the Camden County Affirmative Action Plan as "a business which is independently owned and operated and is at least 51% owned and controlled by women".

Using the definitions above, please check the following space which best describes your firm:

- Minority Business Enterprise (MBE)**
- Women Business Enterprise (WBE)**
- Neither**

**EXHIBIT K**  
**CERTIFICATION OF NON-DEBARMENT**  
**FOR FEDERAL GOVERNMENT CONTRACTS**  
N.J.S.A. 52:32-44.1 (P.L. 2019, c.406)

This certification shall be completed, certified to, and submitted to the contracting unit prior to contract award, except for emergency contracts where submission is required prior to payment.

<b>PART I: VENDOR INFORMATION</b>	
Individual or Organization Name	
Physical Address of Individual or Organization	
Unique Entity ID (if applicable)	
CAGE/NCAGE Code (if applicable)	
<b>Check the box that represents the type of business organization:</b>	

- Sole Proprietorship (skip Parts III and IV)   
 Non-Profit Corporation (skip Parts III and IV)  
 For-Profit Corporation (any type)   
 Limited Liability Company (LLC)   
 Partnership  
 Limited Partnership   
 Limited Liability Partnership (LLP)  
 Other (be specific): \_\_\_\_\_

<b>PART II – CERTIFICATION OF NON-DEBARMENT: Individual or Organization</b>			
I hereby certify that the <b>individual or organization listed above in Part I</b> is not debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the County of Camden is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the County to notify the County of Camden in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the County, permitting the County to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

<b>PART III – CERTIFICATION OF NON-DEBARMENT: Individual or Entity Owning Greater than 50 Percent of Organization</b>	
<b>Section A (Check the Box that applies)</b>	
<input type="checkbox"/>	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of its voting stock, or of the partner in the partnership who owns more than 50 percent interest therein, or of the member of the limited liability company owning more than 50 percent interest therein, as the case may be.
<b>Name of Individual or Organization</b>	
<b>Physical Address</b>	
<b>OR</b>	

<input type="checkbox"/>	No one stockholder in the corporation owns more than 50 percent of its voting stock, or no partner in the partnership owns more than 50 percent interest therein, or no member in the limited liability company owns more than 50 percent interest therein, as the case may be.		
<b>Section B (Skip if no Business entity is listed in Section A above)</b>			
<input type="checkbox"/>	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of the voting stock of the organization's parent entity, or of the partner in the partnership who owns more than 50 percent interest in the organization's parent entity, or of the member of the limited liability company owning more than 50 percent interest in organization's parent entity, as the case may be.		
<b>Stockholder/Partner/Member Owning Greater Than 50 Percent of Parent Entity</b>			
<b>Physical Address</b>			
<b>OR</b>			
<input type="checkbox"/>	No one stockholder in the parent entity corporation owns more than 50 percent of its voting stock, no partner in the parent entity partnership owns more than 50 percent interest therein, or no member in the parent entity limited liability company owns more than 50 percent interest therein, as the case may be.		
<b>Section C – Part III Certification</b>			
I hereby certify that no individual or organization that is debarred by the federal government from contracting with a federal agency owns greater than 50 percent of the <b>Organization listed above in Part I</b> or, if applicable, owns greater than 50 percent of a parent entity of the County of Camden. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the County of Camden is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the County to notify the County in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the County, permitting the County to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

Part IV – CERTIFICATION OF NON-DEBARMENT: Contractor – Controlled Entities			
<b>Section A</b>			
<input type="checkbox"/>	Below is the name and address of the corporation(s) in which the <b>Organization listed in Part I</b> owns more than 50 percent of voting stock, or of the partnership(s) in which the <b>Organization listed in Part I</b> owns more than 50 percent interest therein, or of the limited liability company or companies in which the <b>Organization listed above in Part I</b> owns more than 50 percent interest therein, as the case may be.		
<b>Name of Business Entity</b>		<b>Physical Address</b>	
**Add additional sheets if necessary**			
<b>OR</b>			
<input type="checkbox"/>	The <b>Organization listed above in Part I</b> does not own greater than 50 percent of the voting stock in any corporation and does not own greater than 50 percent interest in any partnership or any limited liability company.		
<b>Section B (skip if no business entities are listed in Section A of Part IV)</b>			
<input type="checkbox"/>	Below are the names and addresses of any entities in which an entity listed in Part III A owns greater than 50 percent of the voting stock (corporation) or owns greater than 50 percent interest (partnership or limited liability company).		
<b>Name of Business Entity Controlled by Entity Listed in Section A of Part IV</b>		<b>Physical Address</b>	
**Add additional Sheets if necessary**			
<b>OR</b>			
<input type="checkbox"/>	No entity listed in Part III A owns greater than 50 percent of the voting stock in any corporation or owns greater than 50 percent interest in any partnership or limited liability company.		
<b>Section C – Part IV Certification</b>			
I hereby certify that the <b>Organization listed above in Part I</b> does not own greater than 50 percent of any entity that that is debarred by the federal government from contracting with a federal agency and, if applicable, does not own greater than 50 percent of any entity that in turns owns greater than 50 percent of any entity debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the County of Camden is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the County to notify the County in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the County, permitting the County to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

**EXHIBIT L**

**EXTENSION OF PRICES TO REGISTERED SYSTEM MEMBERS (OTHER AGENCIES)**

The undersigned is further:  
**(ONE BOX ONLY MUST BE CHECKED)**

WILLING to provide the item(s) herein bid upon to registered system members of the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, without substitution or deviation from specifications, size, features, quality, price or availability as herein set forth. It is understood that orders will be placed directly by the registered members identified herein by separate contract, subject to the overall terms of the Master Contract to be awarded by the County of Camden, and that no additional service or delivery charges will be allowed except as permitted by these specifications.

NOT WILLING to extend prices to registered system members of the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, who have submitted estimates as described above. It is understood that this will not adversely affect consideration of this bid with respect to the needs of Camden County as the Lead Agency.

**EXHIBIT M**

**DISCLOSURE OF SUBCONTRACTORS AND SITES  
AND CERTIFICATION OF COMPLIANCE**

**(FOR BIDS FOR TEXTILES AND/OR ITEMS OF APPAREL ONLY)**

1. DISCLOSURE OF SUBCONTRACTORS AND SITES – SEE PARAGRAPH 23.1

a. List the name and address of each subcontractor to be used in the provision of the goods or services which are the subject of this bid. If extra space is required, please attach additional pages as needed.

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b. List the name and address of all locations, including subcontractor locations, substantially involved in the production of the goods or services which are the subject of this bid. If extra space is required, please attach additional pages as needed.

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2. CERTIFICATION OF COMPLIANCE – SEE PARAGRAPH 23.2

I hereby certify that each of the above-referenced locations, including subcontractor locations, substantially involved in producing or distributing the goods or services which are the subject of this bid, meet the standards set forth in Paragraph 23.2 of these specifications.

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Type Name & Title)

\_\_\_\_\_  
(Date)

**EXHIBIT N**

**BIDS FOR CONSTRUCTION  
DISCLOSURE OF SUBCONTRACTORS**

Please list the subcontractors for the specialty trade categories listed below. If you intend to perform the work through your own employees or by yourself rather than through utilization of a subcontractor, write the word "In-House" next to each applicable category and insert the name, and license number where required, of each person in the appropriate spaces. If the contract does not involve a specialty trade listed below, write the word "None" in the appropriate space. For further instructions, see Paragraph 26 herein. **DO NOT LEAVE ANY SECTION BLANK.**

**1. Plumbing and Gas Fitting and All Kindred Work:**

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

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

License Number: \_\_\_\_\_

**2. Steam Power Plants, Steam and Hot Water Heating and Ventilating Apparatus, and All Kindred Work:**

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

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

License Number: Not Applicable

**3. Electrical Work:**

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

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

License Number: \_\_\_\_\_

**4. Structural Steel and Ornamental Iron Work:**

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

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

License Number: Not Applicable



**EXHIBIT O**

**RESERVED**

**EXHIBIT P**

**AMERICANS WITH DISABILITIES ACT  
Mandatory Language**

Equal Opportunity for Individuals with Disabilities.

The Contractor and the County do hereby agree that the provisions of Title II of the Americans With Disabilities Act of 1990 (the "Act") (42 U.S.C. s12101 et seq.), which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant thereunto, are made a part of this contract. In providing any aid, benefit, or service on behalf of the County pursuant to this contract, the Contractor agrees that the performance shall be in strict compliance with the Act. In the event that the Contractor, its agents, servants, employees, or subcontractors violate or are alleged to have violated the Act during the performance of this contract, the Contractor shall defend the County in any action or administrative proceeding commenced pursuant to this Act. The Contractor shall indemnify, protect, and save harmless the County, its agents, servants, and employees from and against any and all suits, claims, losses, demands, or damages of whatever kind or nature arising out of or claimed to arise out of the alleged violation. The Contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs and other expenses arising from such action or administrative proceeding or incurred in connection therewith. In any and all complaints brought pursuant to the County's grievance procedure, the Contractor agrees to abide by any decision of the County, which is rendered pursuant to, said grievance procedure. If any action or administrative proceeding results in an award of damages against the County or if the County incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the Contractor shall satisfy and discharge the same at its own expense.

The County shall, as soon as practicable after a claim has been made against it, give written notice thereof to the Contractor along with full and complete particulars of the claim. If any action or administrative proceeding is brought against the County or any of its agents, servants, and employees, the County shall expeditiously forward or have forwarded to the Contractor every demand, complaint, notice, summons, pleading, or other process received by the County or its representatives.

It is expressly agreed and understood that any approval by the County of the services provided by the Contractor pursuant to this contract will not relieve the Contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless the Owner pursuant to this paragraph.

It is further agreed and understood that the Owner assumes no obligation to indemnify or save harmless the Contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this agreement. Furthermore, the Contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the Contractor's obligations assumed in this agreement, nor shall they be construed to relieve the Contractor from any liability, nor preclude the Owner from taking any other actions available to it under any other provisions of this agreement or otherwise at law.

**EXHIBIT Q**

**COUNTY OF CAMDEN  
ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA**

**BIDDER REQUIRED TO COMPLETE AND RETURN FORM WITH BID REGARDLESS OF  
WHETHER ADDENDA WAS ISSUED.  
FAILURE TO COMPLETE AND RETURN FORM IS A FATAL DEFECT WHICH CANNOT BE  
CURED AND BID WILL BE REJECTED.**

**A.** Bidder hereby acknowledges receipt of the following Addenda:

<u>Addendum Number</u>	<u>Dated</u>	<u>Initial</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**OR:**

**B.** Bidder acknowledges to the best of his/her knowledge no addendum has been issued by the County: \_\_\_\_\_ Dated \_\_\_\_\_ Initial \_\_\_\_\_

**Bidder is required to complete, sign and submit form with bid regardless of whether addenda were issued. Failure to complete and return form is a fatal defect which cannot be cured and bid will be rejected. See: N.J.S.A. 40A:11-23.2**

By: \_\_\_\_\_  
(Print or Type Name of Authorized Individual)

Signature: \_\_\_\_\_

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

**EXHIBIT R**

**COUNTY OF CAMDEN  
UNIFORMED LAW ENFORCEMENT OFFICERS REQUIREMENT**

Pursuant to N.J.S.A. 40A:11-23.1(c), the County has determined the following:

- (    )            Uniformed law enforcement officers **are not required** for the project.
- (    )            Uniformed law enforcement officers **are required** for the project.

Reasonable estimate of costs for the following:

traffic control personnel	\$ _____
vehicles	\$ _____
equipment	\$ _____
administrative	\$ _____
other (specify)	
_____	\$ _____
_____	\$ _____
_____	\$ _____
_____	\$ _____
Total costs	\$ _____

The above costs associated with additional traffic control required by the County have been reasonably estimated in cooperation and consultation with the following municipalities affected by the project.

Name of Municipality	Contact person
_____	_____
_____	_____
_____	_____
_____	_____

## EXHIBIT S

### Disclosure of Investment Activities in Iran

<b>Person or Entity:</b>	
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#### **Part 1: Certification**

BIDDERS ARE TO COMPLETE PART 1 BY CHECKING **EITHER BOX**.

Pursuant to Public Law 2012, c. 25, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified on the Department of Treasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The Chapter 25 list is found on the N.J. Division of Purchase and Property website at [www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf](http://www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf). Bidders must review this list prior to completing the below certification. Failure to complete the certification may render a bidder's proposal non-responsive. If a person or entity is found to be in potential violation of law, the matter shall be referred to the State Attorney General who shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

#### CHECK THE APPROPRIATE BOX:

I certify, pursuant to Public Law 2012, c. 25, that neither the bidder listed above nor any of the bidder's parents, subsidiaries, or affiliates is listed on the N.J. Department of the Treasury's list of entities determined to be engaged in prohibited activities in Iran pursuant to P.L. 2012, c. 25 ("Chapter 25 List"). I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf. I will skip Part 2 and sign and complete the Certification below.

**OR**

I am unable to certify as above because the bidder and/or one or more of its parents, subsidiaries, or affiliates is listed on the Department's Chapter 25 list. I will provide a detailed, accurate and precise description of the activities in Part 2 below sign and complete the Certification below. Failure to provide such will result in the proposal being rendered as nonresponsive and appropriate penalties, fines and/or sanctions will be assessed as provided by law.

#### **Part 2 – Additional Information**

PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT ACTIVITIES IN IRAN. You must provide a detailed, accurate and precise description of the activities of the bidding person/entity, or one of its parents, subsidiaries or affiliates, engaging in the investment activities in Iran on additional sheets provided by you.

#### **Part 3: Certification**

I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments there to the best of my knowledge are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity. I acknowledge that the Contracting Unit is relying on the information contained herein and thereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the Contracting Unit to notify the Contracting Unit in writing of any changes to the answers of information contained herein. I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the Contracting Unit and that the Contracting Unit at its option may declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

## Exhibit T

### CERTIFICATION OF NON-INVOLVEMENT IN PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS

Pursuant to N.J.S.A. 52:32-60.1, et seq. (L. 2022, c. 3) any person or entity (hereinafter "Vendor ") that seeks to enter into or renew a contract with the County for the provision of goods or services, or the purchase of bonds or other obligations, or be designated as a redeveloper, must complete the certification below indicating whether or not the Vendor is identified on the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, available here: <https://sanctionssearch.ofac.treas.gov/>. If the County finds that a Vendor has made a certification in violation of the law, it shall take any action as may be appropriate and provided by law, rule, or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default, and seeking debarment or suspension of the party.

I, the undersigned, certify that I have read the definition of "Vendor" below, and have reviewed the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, and having done so certify:

(Circle the Appropriate Letter)

A. That the Vendor is not identified on the OFAC Specially Designated Nationals and Blocked Persons list on account of activity related to Russia and/or Belarus. OR

B. That I am unable to certify as to "A" above because the Vendor is identified on the OFAC Specially Designated Nationals and Blocked Persons list on account of activity related to Russia and/or Belarus. OR

C. That I am unable to certify as to "A" above because the Vendor is identified on the OFAC Specially Designated Nationals and Blocked Persons list. However, the Vendor is engaged in activity related to Russia and/or Belarus consistent with federal law, regulation, license, or exemption. A detailed description of how the Vendor's activity related to Russia and/or Belarus is consistent with federal law is set forth below.

Attach Additional Sheets If Necessary.)

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Signature of Vendor's Authorized Representative                      Date

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Print Name & Title of Vendor's Authorized Representative                      Email

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Vendor's Name, Address (City/State/Zip Code) & Phone Number)

Vendor means: (1) A natural person, corporation, company, limited partnership, limited liability partnership, limited liability company, business association, sole proprietorship, joint venture, partnership, society, trust, or any other nongovernmental entity, organization, or group; (2) Any governmental entity or instrumentality of a government, including a multilateral development institution, as defined in Section 1701(c)(3) of the International Financial Institutions Act, 22 U.S.C. 262r(c)(3); or (3) Any parent, successor, subunit, direct or indirect subsidiary, or any entity under common ownership or control with, any entity described in paragraph (1) or (2).

## **EXHIBIT U**

### **NEW JERSEY ANTI-DISCRIMINATION PROVISIONS N.J.S.A. 10:2-1 et seq.**

Pursuant to N.J.S.A. 10:2-1, if awarded a contract, the contractor agrees that:

- a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this contract, no contractor, nor any person acting on behalf of such contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;
- b. No contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;
- c. There may be deducted from the amount payable to the contractor by the contracting public agency, under this contract, a penalty of \$50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the contract; and
- d. This contract may be canceled or terminated by the contracting public agency, and all money due or to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the contractor from the contracting public agency of any prior violation of this section of the contract.

No provision in this section shall be construed to prevent a board of education from designating that a contract, subcontract or other means of procurement of goods, services, equipment or construction shall be awarded to a small business enterprise, minority business enterprise or a women's business enterprise pursuant to P.L. 1985, c.490 (C.18A:18A-51 et seq.).

## Exhibit V

### **40A:11-16.7. Changed conditions contract provisions; inclusion in certain construction contracts**

**a. A contract subject to this section shall include the following differing site conditions provisions:**

(1) If the contractor encounters differing site conditions during the progress of the work of the contract, the contractor shall promptly notify the contracting unit in writing of the specific differing site conditions encountered before the site is further disturbed and before any additional work is performed in the impacted area.

(2) Upon receipt of a differing site conditions notice in accordance with paragraph (1) of this subsection, or upon the contracting unit otherwise learning of differing site conditions, the contracting unit shall promptly undertake an investigation to determine whether differing site conditions are present.

(3) If the contracting unit determines different site conditions that may result in additional costs or delays exist, the contracting unit shall provide prompt written notice to the contractor containing directions on how to proceed.

(4)(a) The contracting unit shall make a fair and equitable adjustment to the contract price and contract completion date for increased costs and delays resulting from the agreed upon differing site conditions encountered by the contractor.

(b) If both parties agree that the contracting unit's investigation and directions decrease the contractor's costs or time of performance, the contracting unit shall be entitled to a fair and equitable downward adjustment of the contract price or time of performance.

(c) If the contracting unit determines that there are no differing site conditions present that would result in additional costs or delays, the contracting unit shall so advise the contractor, in writing, and the contractor shall resume performance of the contract, and shall be entitled to pursue a differing site conditions claim against the contracting unit for additional compensation or time attributable to the alleged differing site conditions.

(5) Execution of the contract by the contractor shall constitute a representation that the contractor has visited the site and has become generally familiar with the local conditions under which the work is to be performed.

(6) As used in this subsection, "differing site conditions" mean physical conditions at the contract work site that are subsurface or otherwise concealed and which differ materially from those indicated in the contract documents or are of such an unusual nature that the conditions differ materially from those ordinarily encountered and generally recognized as inherent in the work of the character provided for in the contract.

**b. A contract subject to this section shall include the following suspension of work provisions:**

(1) The contracting unit shall provide written notice to the contractor in advance of any suspension



of work lasting more than 10 calendar days of the performance of all or any portion of the work of the contract.

(2) If the performance of all or any portion of the work of the contract is suspended by the contracting unit for more than 10 calendar days due to no fault of the contractor or as a consequence of an occurrence beyond the contracting unit's control, the contractor shall be entitled to compensation for any resultant delay to the project completion or additional contractor expenses, and to an extension of time, provided that, to the extent feasible, the contractor, within 10 calendar days following the conclusion of the suspension, notifies the contracting unit, in writing, of the nature and extent of the suspension of work. The notice shall include available supporting information, which information may thereafter be supplemented by the contractor as needed and as may be reasonably requested by the contracting unit. Whenever a work suspension exceeds 60 days, upon seven days' written notice, either party shall have the option to terminate the contract for cause and to be fairly and equitably compensated therefor.

(3) Upon receipt of the contractor's suspension of work notice in accordance with paragraph (2) of this subsection, the contracting unit shall promptly evaluate the contractor's notice and promptly advise the contractor of its determination on how to proceed in writing.

(4)(a) If the contracting unit determines that the contractor is entitled to additional compensation or time, the contracting unit shall make a fair and equitable upward adjustment to the contract price and contract completion date.

(b) If the contracting unit determines that the contractor is not entitled to additional compensation or time, the contractor shall proceed with the performance of the contract work, and shall be entitled to pursue a suspension of work claim against the contracting unit for additional compensation or time attributable to the suspension.

(5) Failure of the contractor to provide timely notice of a suspension of work shall result in a waiver of a claim if the contracting unit can prove by clear and convincing evidence that the lack of notice or delayed notice by the contractor actually prejudiced the contracting unit's ability to adequately investigate and defend against the claim.

**c. A contract subject to this section shall include the following change in character of work provisions:**

(1) If the contractor believes that a change directive by the contracting unit results in a material change to the contract work, the contractor shall so notify the contracting unit in writing. The contractor shall continue to perform all work on the project that is not the subject of the notice.

(2) Upon receipt of the contractor's change in character notice in accordance with paragraph (1) of this subsection, the contracting unit shall promptly evaluate the contractor's notice and promptly advise the contractor of its determination on how to proceed in writing.

(3)(a) If the contracting unit determines that a change to the contractor's work caused or directed by the contracting unit materially changes the character of any aspect of the contract work, the contracting unit shall make a fair and equitable upward adjustment to the contract price and contract completion date. The basis for any such price adjustment shall be the difference between

the cost of performance of the work as planned at the time of contracting and the actual cost of such work as a result of its change in character, or as otherwise mutually agreed upon by the contractor and the contracting unit prior to the contractor performing the subject work.

(b) If the contracting unit determines that the contractor is not entitled to additional compensation or time, the contractor shall continue the performance of all contract work and shall be entitled to pursue a claim against the contracting unit for additional compensation or time attributable to the alleged material change.

(4) As used in this subsection, “material change” means a character change which increases or decreases the contractor’s cost of performing the work, increases or decreases the amount of time by which the contractor completes the work in relation to the contractually required completion date, or both.

**d. A contract subject to this section shall include the following change in quantity provisions:**

(1) The contracting unit may increase or decrease the quantity of work to be performed by the contractor.

(2)(a) If the quantity of a pay item is cumulatively increased or decreased by 20 percent or less from the bid proposal quantity, the quantity change shall be considered a minor change in quantity.

(b) If the quantity of a pay item is increased or decreased by more than 20 percent from the bid proposal quantity, the quantity change shall be considered a major change in quantity.

(3) For any minor change in quantity, the contracting unit shall make payment for the quantity of the pay item performed at the bid price for the pay item.

(4)(a) For a major increase in quantity, the contracting unit or contractor may request to renegotiate the price for the quantity in excess of 120 percent of the bid proposal quantity. If a mutual agreement cannot be reached on a negotiated price for a major quantity increase, the contracting unit shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original bid.

(b) For a major decrease in quantity, the contracting unit or contractor may request to renegotiate the price for the quantity of work performed. If a mutual agreement cannot be reached on a negotiated price for a major quantity decrease, the contracting unit shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original bid; provided, however, that the contracting unit shall not make a payment in an amount that exceeds 80 percent of the value of the bid price multiplied by the bid proposal quantity.

(5) As used in this subsection, the term “bid proposal quantity” means the quantity indicated in the bid proposal less the quantities designated in the project plans as “if and where directed.”

NEW PAVILION AT HADDON LAKE PARK  
BOROUGH OF HADDON HEIGHTS, CAMDEN COUNTY

# PROPOSAL

## PROPOSAL

### NEW PAVILION AT HADDON LAKE PARK, BOROUGH OF HADDON HEIGHTS, CAMDEN COUNTY

The Undersigned hereby declares that he/she carefully examined the Advertisement, Standard Specifications, Supplementary Specifications Plans and Forms for this Construction of the Project named above; that he/she carefully examined the site of the Project as provided in Article 102.06 of the Standard Specifications and that he/she will contract to carry out and complete the said projects as specified and delineated at the Price per Unit of measure for each schedule item of work in the Schedule of Prices following.

It is understood that the **TOTAL PRICE** stated by the undersigned in the Schedule of Prices is based on the estimated quantities and that the extension of the unit price times the quantity will control each bid item cost in determining the TOTAL PRICE for the awarding the Contract as provided in Article 103.01 of the Standard Specifications. It is further understood that the quantities stated in the Schedule of Prices for the various items are estimates only and may be decreased or increased as provided in the Specifications.

Note: Extension of Unit Prices must be exact.

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**Contract Time:**

<b>Substantial Completion:</b>	<b>One Hundred and Eighty (180)</b>	Calendar Days
<b>Final Completion:</b>	<b>Two Hundred and Ten (210)</b>	Calendar Days

Note: If the Contractor fails to complete the project and each and every part and appurtenance thereof fully, entirely and in conformity with the provisions of the contract within the times stated in the contract, or within such further time as may have been granted in accordance with the provisions of the contract, then the County may withhold permanently from the Contract's total compensation the appropriate amount of \$500.00 for each and every day that the work remains incomplete, which said amount shall not be considered a penalty, but liquidated damages for the loss, inconvenience and extra expense to the County by such delays.

Note: It is recognized that no two pieces of equipment and no two products are engineered or designed exactly the same. Trade names, brand names and models specified herein are provided to establish a minimum standard of quality acceptable to the County for this bid. Substitute brands, makes and models shall be considered and reviewed on the basis of their ability to perform the specified tasks or provide the same quality of goods as specified in the County's bid. This is known as an "Equivalent". If the bidder seeks to provide an Equivalent product or good, the bidder shall with its bid submission include specifications or cut sheets for such proposed Equivalent product or good. The County's Architect/Engineer for the bid shall review the submission provided by the bidder to determine whether the product or good is an Equivalent to the bid specification. The County's Architect/Engineer for the bid shall have the final decision on whether a bidder's submitted product specifications are an Equivalent to the named product(s) or good(s) in this bid.

Note: Should any requirements in the contract documents be found to conflict with the County's general bid boilerplate (the ITB pages) the general bid boilerplate provisions and language shall prevail.

NEW PAVILION AT HADDON LAKE PARK  
BOROUGH OF HADDON HEIGHTS, CAMDEN COUNTY

**PROPOSAL**  
  
**NEW PAVILION AT HADDON LAKE PARK**  
**BOROUGH OF HADDON HEIGHTS, CAMDEN COUNTY**

Item No	Items	Unit	Quantity	Unit Price (\$)	Amount (\$)
<b>BASE BID</b>					
1	CLEARING SITE	LS	1	\$	\$
2	EARTHWORK	LS	1	\$	\$
3	CONCRETE SIDEWALK, EXPOSED AGGREGATE, 4' THICK	SY	85	\$	\$
4	CONCRETE PAD, REINFORCED, EXPOSED AGGREGATE, 6" THICK	SY	35	\$	\$
5	TOILET ENCLOSURE	UN	1	\$	\$
6	INLET, TYPE A	UN	1	\$	\$
7	12" HIGH DENSITY POLYETHYLENE PIPE	LF	85	\$	\$
8	6" POLYVINYL CHLORIDE PIPE	LF	100	\$	\$
9	WATER LATERAL, 3/4" DIAMETER, COPPER, TYPE K	LF	15	\$	\$
10	TOPSOIL SPREADING, 5" THICK	SY	750	\$	\$
11	FERTILIZING AND SEEDING, TYPE A-3	SY	750	\$	\$
12	LANDSCAPING	LS	1	\$	\$
13	BUILDING, PAVILION, COMPLETE	LS	1	\$	\$
14	ELECTRICAL SITE IMPROVEMENTS	LS	1	\$	\$
15	ALLOWANCE	ALLOW	1	\$45,000.00	\$45,000.00

NEW PAVILION AT HADDON LAKE PARK  
BOROUGH OF HADDON HEIGHTS, CAMDEN COUNTY

	Total Amount BASE BID (\$)				
	Total Amount BASE BID in Words				

The Undersigned is \_\_\_\_\_  
(AN INDIVIDUAL)  
(A PARTNERSHIP)  
(A CORPORATION)

Under the Laws of the State of \_\_\_\_\_ having

Principal Offices at \_\_\_\_\_.

Signature \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Dated \_\_\_\_\_

# **TECHNICAL SPECIFICATIONS**

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DEBARMENT LIST

The list of debarred firms and individuals can be reviewed at the following web address:  
[https://www.nj.gov/labor/wagehour/wagerate/prevailing\\_wage\\_debarment\\_list.html](https://www.nj.gov/labor/wagehour/wagerate/prevailing_wage_debarment_list.html)

PREVAILING COUNTY & STATE WAGE RATES

Prevailing wage rates are available online at the following web address:  
[https://www.nj.gov/labor/wagehour/wagerate/pwr\\_construction.html](https://www.nj.gov/labor/wagehour/wagerate/pwr_construction.html).

A copy will be included with each contract set provided to the awarded contractor.

*END OF TABLE*

## SCOPE OF WORK

### PART 1 - GENERAL

#### 1.1 WORK COVERED BY CONTRACT DOCUMENTS

Owner Identification: Camden County Department of Parks  
1301 Park Boulevard  
Cherry Hill, New Jersey 08002

Engineer Identification: Remington & Vernick Engineers  
2059 Springdale Road  
Cherry Hill, NJ 08002

##### A. General:

1. Review of all existing site conditions is strongly recommended to fully understand the scope of work.

##### B. DESCRIPTION

In general, the work on this project consists of the construction of a new building consisting of a multi-purpose room, changing room, utility room and outdoor covered patio. Also included in the scope shall be the construction of various site improvements to including, but not limited to; sidewalk, grading, and landscaping for the Camden County Parks Department.

All materials and construction shall be in accordance with, including but not limited to, the latest version of the New Jersey Sanitary Code Chapter IX – Public Recreational Bathing N.J.A.C. 8:26, National Sanitation Foundation (NSF), Uniform Construction Code N.J.A.C. 5:23, and the National Electric Code (NEC).

##### C. DESCRIPTION OF WORK

1. The Contractor is responsible and obligated to successfully complete the entire project and to complete each and every necessary detail of every item required per bid documents. **The contractor shall field verify all measurements prior to construction and/or preparation of shop drawings.**

**Contractor is advised that only major items of work are included in the bid form. All work as indicated and incidental to work completion shall be incorporated into the project scope. Scope items not specifically identified for payment shall have costs included in various lump sum items of the bid form.**

2. Contractor shall be responsible for furnishing and installing all soil erosion and sediment control per the contract documents.

3. Contractor shall be responsible for selective demolition of fencing, utilities, pavement, and landscaping as shown on the contract documents.
4. Construction of concrete walkways and pad, toilet enclosure, onsite utilities and landscaping as shown on the contract documents.
5. Furnish and install new building construction facilities complete per the contract documents. Contractor shall be responsible to provide all items as listed on the project drawings and specifications and price shall include, but is not limited to, foundations, structural concrete, DGA, wall systems, roof systems and accessories, architectural elements and finishes, furniture, and all appurtenances and all costs necessary to provide a fully functional building space for construction of process, mechanical, plumbing, and electrical equipment.
  - a. Proposed new building construction shall include the following:
    - 1) Multi-purpose room, changing room, utility room and covered patio
6. Equivalent manufacturers have been provided in this specification. Any variations between these manufacturers are considered de minimus. The cost for any and all changes to the design due to variations between the two equivalents, including plumbing, HVAC, electrical, structural, site work, etc., shall be included in the various items bid within the proposal. Separate payment will not be made.
7. The landscape plan includes the installation of trees and shrubs, as well as installation of topsoil and seed.

## 1.2 SPECIAL CONDITIONS

1. Contractor shall be given **one hundred eighty (180) calendar days** to complete all work.
2. The Contractor shall be responsible for coordinating all work with the Engineer and the Owner.
3. Prior to bidding, the Contractor shall visit the site and include all costs for a complete demolition, including review of existing site conditions. The Owner is not responsible for additional costs based on the contractor failure to properly inspect the existing conditions and include all costs in his bid.
4. The existing building plans are provided in the project plans for the contractor's reference only. The contractor is responsible for verifying all existing information.
5. All work not specifically described or listed in the specifications that are incidental to work completion shall be considered as included within scope.
6. Extra work allowance is only to be used at the owner's/engineer's discretion.
7. A preconstruction video or photographs is required. No separate payment will be made for this requirement, but all costs shall be included in one of the lump sum unit prices bid.

8. Contractor is responsible for clean-up of site and shall provide dumpsters as required.
9. Night and/or weekend work shall be permitted at no additional cost to owner.
10. Contractor shall be responsible for applying and obtaining the required permits from the Borough of Haddon Heights for this work, including permit fees.

E. MISCELLANEOUS

1. The above Scope of Work outlines the general items and distribution of work and shall not be construed as being all inclusive.
2. Contractor shall be responsible for coordinating his work and that of all other contractors on the project. Any costs related to his coordinating shall be included in his proposal.
3. Contractor is responsible for coordinating all utility mark outs prior to construction.
4. Contractor shall not have exclusive possession of the site during construction. In the performance of the work, the contractor shall cooperate fully with the maintenance or work crews of the owner and, when as directed by the Engineer or the owner, with representatives of Camden County and the State of New Jersey.
5. Contractor shall:
  - i. Assume full responsibility for protection and safekeeping of products stored on and off premises.
  - ii. Move stored products that interfere with the operations of owner or other contractors.
  - iii. Obtain and pay for all additional storage or work areas required for his operations.
  - iv. Not unreasonably encumber the site with materials and equipment.
6. Contractor shall provide personnel attendance at progress meetings.

END OF SCOPE

## SECTION 01000

### GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 General

- A. Only major items of work are given in the Bid Form, but it is the intent of the specifications to secure a completely interconnected and functional system, and should any workmanship or materials be required which are obviously necessary to carry out the full intent and meaning of the plans and specifications or to be reasonably inferred therefrom, the cost of such workmanship or materials shall be included in the items in the bid form.
- B. Where construction is being performed in traveled roadways or rights-of-way, the Contractor is to provide all necessary traffic controls and devices in accordance with the current New Jersey Department of Transportation standards.
- C. The Contractor shall notify all utility companies prior to Construction of utilities, curbing and paving.
- D. Prior to any excavation, the Contractor shall have all utilities marked and shall excavate or otherwise determine the exact location and elevations of said utilities. The Contractor shall notify the Engineer of any conflicts. The Contractor shall arrange for any necessary utility relocations or field changes and shall reschedule his operations appropriately.
- E. The Contractor, in the construction of the project, shall not stockpile materials or store equipment on any private property; except areas designated by the plans or as directed by the Engineer. If so required, the Engineer may direct the Contractor to have equipment removed from any project during weekend hours.
- F. All work of refilling sunken ditches, repaving over trenches and keeping streets and sidewalks in passable condition shall be done to the satisfaction of the Owner during the construction of the project as well as during the maintenance period. If any remedial work is not done within three (3) days after written notice is given by the Engineer, the work may be done by the Owner and charged to the Contractor.
- G. Special care shall be taken to prevent contamination, siltation, or interference of any kind with the stream flows or ponds along the line of work. No waste matter of any kind will be allowed to discharge into the stream flows or impounded water of any ponds or other bodies of water.
- H. The Contractor is to ensure that proper measures for erosion control are employed and provide for the early establishment of vegetation that will help avoid erosion problems during and after construction. It is expected that the Contractor will anticipate possible problems and provide timely and adequate control to prevent or minimize adverse effects.
- I. The Contractor shall apply and pay for all permits that may be required for any of the work involved with this project.

- J. The Contractor is to notify residents by door-hangers, at least forty-eight (48) hours in advance, before starting construction work that will directly affect their property frontage, driveway(s) and/or on-street parking.
- K. All notes on plans shall be made a part of the specifications.
- L. The Contractor shall notify the Engineer at least forty-eight (48) hours in advance of any work scheduled for Saturdays. There will be no work permitted on Sundays or holidays. This project will receive full-time inspection and the normal working hours for the Inspector are from 7:00 AM to 3:30 PM, Monday through Friday. Any overtime inspection costs which are avoidable will be reimbursed by the Contractor.
- M. During the construction phase of the project, travel lanes shall remain open at the end of each day.
- N. The Contractor shall take extreme care in the placement of the asphaltic tack coat so as to not make it visible on the concrete curb or inlet top units. It shall be the Contractor's responsibility to keep the concrete curb and inlet top units clean of this material.
- O. Separate payment will not be made for construction layout. The costs for construction layout for all site work shall be included in the various items of the proposal.

#### 1.02 Public Utilities

- A. The Contractor is required to ascertain all the facts concerning the location of utilities.
- B. The Contractor shall cooperate with the utility Owners in the adjustment of their facilities and shall notify the utility Owners not less than ten (10) days in advance of the time scheduled to perform any work that will impact or affect their facilities.
- C. The Contractor shall permit the Owners of utilities, or their agents, access to the site of the work at all times in order to relocate, construct or protect their lines and he shall cooperate with them in performing this work.
- D. Separate payments will not be made for the coordination and cooperation of the Contractor with the utility companies, nor for the protection or replacement of utilities as specified hereinbefore and the bidder shall include all such costs in the prices bid for the various scheduled items in the Bid Form.

#### 1.03 Preconstruction Video

- A. The Contractor shall, at no extra cost to the Owner, take video recordings of the site prior to the commencement of construction. The video recording shall accurately depict the existing preconstruction condition of all curbs, sidewalks, driveways, fences, lawns, landscaped area, mailboxes, street furniture and all other appurtenances within, or outside a 25 foot radius of the limits of the construction of the project. One (1) copy of the video recording shall be provided to the Engineer. The date of the video, as well as identification as to the location which the video depicts must be provided.

#### 1.04 Maintenance and Protection of Traffic



- A. The Contractor shall erect or place and maintain in good condition, barricades, warning signs, lights, flares, approved yellow-flashing light units, rubber traffic cones, and other warning and danger signals and devices, appropriate and adequate for the specific needs and subject to the Engineer's approval, at working sites, closed roads, intersections, open excavations, locations of material storage, standing equipment and other obstructions, at points where the usable vehicular or pedestrian traffic width of the road or sidewalk is reduced, at points where traffic is deflected from its normal courses or lanes, and at other places of danger to vehicular or pedestrian traffic.
- B. The Contractor shall provide sufficient watchmen and traffic directors and shall take all other precautions, including any that may be ordered by the Engineer, which are necessary for the safety of the public and protection of the work.
- C. The Contractor shall obtain the approval of the Engineer and consent of all appropriate authorities having jurisdiction, for any detours which may be required. The Contractor shall make all necessary arrangements with such authorities regarding the establishment, maintenance and repair of such detours, the regulations and direction of traffic thereon, and the installation and maintenance of signs and traffic devices.
- D. Before beginning work on any phase of the project, the Contractor shall furnish and install warning signals, barricades, wood traffic guides, lights, flares and other devices necessary, in the opinion of the Engineer, to protect the public during that phase of his operations.
- E. If battery operated flashing warning lights are used, they shall conform to the specifications prepared by The New Jersey Department of Transportation, Official Traffic Control Devices. These specifications require, in part, that the flashing lights be weatherproof and reasonably tamper-proof and theft proof, be equipped with seven inch (7") minimum diameter amber plastic lens, shall operate with a flash rate of between 55 and 75 flashes per minute with a flash duration of not less than 18% of each flash cycle; and shall be inspected and cleaned daily so as to maintain the lights in the proper working condition.
- F. Road construction signs shall be placed at each end of the project along with every connecting intersection. At the start and end of each day, detour signs shall be placed if required.
- G. During the work on this project, the Contractor shall provide and/or be prepared to provide traffic protection devices in accordance with the Manual on Uniform Traffic Control Devices. The minimum numbers set forth in the Schedule shall be on hand at each separate project site prior to the commencement of any work (or phase of work) and shall be maintained available on the project site throughout the period of the project (or phase). Failure to provide and maintain the minimum number of devices shall be sufficient cause for the Engineer to order cessation of work. When lack of any required safety devices presents an immediate hazard, the Engineer may order that such devices be provided by the Owner or by other Contractors, deducting the cost thereof from any monies due or becoming due the Contractor lacking the required devices.
- H. Additional devices shall be provided by the Contractor as required or directed prior to the commencement of any operation or phase of an operation requiring such devices.
- I. Uniform traffic directors (flagpersons) shall be provided whenever alternate two-way traffic is maintained in a single lane, whenever Contractor's operations require closing of a lane or

portion of a lane on a multiple lane roadway, whenever the Contractor's equipment or vehicles are entering or leaving active roadways at other than normal street intersections, whenever a Contractor's operations will be contrary to or cause confusion regarding normal traffic control devices (traffic signals, signs, etc.) within a work area and whenever else, in the opinion of the Engineer, the Contractor's operations cause such hazards as to require the use of Traffic Directors.

- J. Traffic Directors shall be responsible and thoroughly familiar with their responsibilities, and, while serving as Traffic Directors, shall not be required to perform any other duties. Traffic Directors shall be provided with an orange or red flag, an orange, orange and white, or lime green traffic safety vest and white or orange hard hat or other appropriate head gear. The Contractor may, at his option, secure the services of uniformed policemen having jurisdiction in the locality within which the project is located. Provision of such uniformed policemen will be deemed sufficient in meeting the requirements of this specification.
- K. Traffic must be maintained throughout each separate work area during construction. At least one 12' lane must be maintained for traffic during all actual construction periods and at least two 10' lanes must be maintained for traffic at all other times.
- L. The Contractor is advised that there may be heavy commuter traffic during the morning from 7:30 AM to 9:00 AM and the afternoon from 3:00 PM to 5:30 PM.
- M. Construction shall be so staged to maintain at least one lane for traffic in each direction throughout each separate work area during the morning 7:30 AM to 9:00 AM and the afternoon 3:00 PM to 5:30 PM weekday periods of peak traffic.
- N. Any restriction of traffic at any time shall be subject to the approval of the Engineer, and the Municipal Police Department. Any restriction of traffic on a New Jersey State Highway shall be subject to regulations and permitting prescribed by The New Jersey Department of Transportation. The Contractor shall submit a schedule of staged construction to the Engineer for approval prior to any restriction of traffic.
- O. Should construction be in close proximity to a school or school traffic route, and be commenced during an active school period, the Contractor shall provide open traffic lanes to accommodate school bus and school related traffic.
- P. If detours are proposed by the Contractor, they are subject to the review and approval of the Engineer, the Municipal Police Department and/or The New Jersey Department of Transportation, as applicable.
- Q. A detour plan and schedule shall be prepared by the Contractor for each proposed detour and submitted to each of the approving agencies previously mentioned. All detour signs shall conform to the requirements for Traffic Control Devices.
- R. Temporary traffic stripes will be necessary to control and guide traffic through individual work areas. The Contractor shall submit a scheme for approval by the Engineer of all temporary traffic stripes prior to removal of any existing traffic stripes.
- S. Construction of proposed utility pipes or storm pipes across existing roadways shall be so staged to maintain one lane in each direction. Trenches shall not remain open overnight.

- T. The Contractor shall provide adequate means of access for fire, police and emergency vehicles throughout the length of the project. Contractor shall also provide for safe and adequate means of access to adjacent properties, both private and public.
- U. The cost of all work as specified hereinbefore and all other work required to protect public safety and maintaining traffic flow shall be included in the prices bid for the various items in the Bid Form, unless specifically requested as a bid item in which case payment will be made as a lump sum.

#### 1.05 Reference to the Standard Specifications

- A. Portions of the work performed under this contract shall comply with the requirements of the Commonwealth of New Jersey Department of Transportation Publication 408, latest edition and supplements and the New Jersey Department of Transportation Standard Construction Details as applicable and all requirements modified, as amended or supplemented and whose specifications are made part of these specifications.
- B. The Standard Specifications are made part of these specifications by this reference as if they were set forth in full. It is the responsibility of the prospective bidder to be familiar with these Standard Specifications.

#### 1.06 Dust Control

- A. The Contractor will be required to maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs. If any dust control is not done within twenty-four (24) hours after written notice is given by the Engineer, the work may be done by the Owner and charged to the Contractor. Costs for dust control shall be included in the prices bid for the various items in the bid form.

#### 1.07 TESTING MATERIALS

- A. Except as may be provided elsewhere, test or analysis of materials which are usually tested after delivery to the site, such as concrete aggregate, mixed and placed concrete, and similar materials; will be performed by a test laboratory which will be approved by the Engineer and selected and paid for by the Contractor. The preliminary testing of concrete mixtures and test or analysis of other materials, samples of which are to be submitted prior to delivery, will also be performed by the laboratory and paid for by the Contractor.
- B. If the Engineer orders sampling and analysis or tests of materials which are usually accepted on certification of the manufacturer but which appear defective or not conforming to the requirements of the Specifications, the Contractor will bear the reasonable costs of sampling, transportation, test and analysis.

#### 1.08 Test Cores and Core Analysis

- A. The Contractor shall be responsible for providing test cores and core analysis of all bituminous concrete surface course and bituminous stabilized leveling and base course items upon completion of these items. Test coring and core analysis shall be performed by a testing laboratory equipped and experienced in performing this work. The testing laboratory shall be approved by the Engineer. Coring and core analysis shall be performed in strict compliance with Section 106 of the Commonwealth of New Jersey Department of Transportation Publication 408.

#### 1.09 Mobilization

- A. DESCRIPTION—This work is the assembly and set-up of the general plant required to comply with the contract and with local and State laws and regulations. General plant includes Contractor's offices, shops, plants, storage areas, and sanitary or other facilities. This work includes obtaining the required permits, insurance, bonds, and any other initial items required for the start of the work.
- B. MATERIAL—These material and furnishings will not be considered a part of the other completed contract items.

### PART 2 – PRODUCTS

Not used

### PART 3 – EXECUTION

Not used

### PART 4 – QUANTITY AND PAYMENT

#### 4.01 General Requirements

- A. Quantity of all other items covered in the General Requirements will not be measured for this project, but the work shall be performed as incidental to the proposed work.
- B. Payment for all other items covered in the General Requirements will not be made for this project, but the cost shall be included in the various items of the proposal.

END OF SECTION 01000

SECTION 01710  
CLEANING AND RESTORATION

1.01 DESCRIPTION

- A. Contractor shall provide all equipment, labor and materials required to clean and restore the site to at least the existing condition.
- B. Maintain premises and public properties free from accumulations of waste, debris and rubbish caused by work operations.
- C. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials; clean all sight exposed surfaces; leave project clean and ready for occupancy.
- D. At completion of project, restore and replace, when and as directed by the Engineer, any public or private property disturbed or damaged by Contractor's work operations to a condition at least equal to that existing prior to beginning work, or as otherwise specified. Materials, equipment and methods shall be approved by the Engineer.

1.02 MATERIALS

- A. For restorations, use the following materials. All materials shall comply with the following Articles of the New Jersey Department of Transportation Standard Specifications latest revisions and these specifications.
- B. Grass restorations: See Section 806 "Fertilizing and Seeding" and Section 808 "Sodding."
- C. Pavement restorations: See Section 401 "Hot Mix Asphalt (HMA) courses."
- D. Restoration of curbs and other concrete structures:
  - 1. Concrete:
    - a. Shall conform to Section 903.
    - b. Compressive Strength: 4,000 psi at 28 days.
    - c. Air-entrained.
  - 2. Joint Fillers: Section 914.01, preformed expansion joint filler.
  - 3. Curing Compound: Section 903.10.
- E. All Other Materials: As approved by the Engineer or authorities as jurisdiction.

1.03 METHOD OF CONDUCTING WORK - CLEANING

A. Requirements of regulatory agencies:

All excess material shall be removed from the site and disposed of by the Contractor at his expense. Cost to be included in the unit price bid for all items. The disposal site shall be in permanently established licensed OSWA (Office of Solid Waste Administration, New Jersey Department of Environmental Protection) landfills.

B. Cleaning during construction:

Provide periodic cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish and windblown debris resulting from construction operations.

Provide on-site containers for the collection of waste materials, debris and rubbish. Maintain containers as required.

C. The Contractor will be required to maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs. If any dust control is not done within twenty-four (24) hours after written notice is given by the Engineer, the work may be done by the Owner and charged to the Contractor.

1.04 METHODS OF CONSTRUCTION

A. General: All existing structures, unpaved areas and paved areas disturbed or damaged during the work under this contract shall be restored or replaced to a condition at least equal to that existing prior to the beginning work, or as otherwise specified. The methods of conducting this work shall, as a minimum, conform to the following Articles of the New Jersey Department of Transportation Standard Specifications, latest revision.

B. Grass Restorations:

See Section 806 "Fertilizing and Seeding" and Section 808 "Sodding."

C. Pavement Restorations:

The method of construction employed shall conform to the requirements set forth in Section 301, 304 and 401 of the Standard Specifications as applicable to the type of material being utilized.

Restoration type and thickness shall be as shown on the contract drawings.

D. Restorations of curbs and other concrete structures:

1. Curbs: Section 607
2. Other concrete structures: Restore in accordance with applicable Articles of the Standard Specifications.

E. All Other Restorations:

Restore in accordance with applicable Articles of the Standard Specifications, or as approved by the Engineer or authorities having jurisdiction.

1.05 QUANTITY AND PAYMENT

- A. All costs for Cleaning and Restorations shall be included in prices bid for various items scheduled in the Proposal.

END OF SECTION

## SECTION 024650

### HELICAL PILES AND ANCHORS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Helical Piles and Anchors.
- B. Load Testing.

##### 1.2 RELATED SECTIONS

- A. Section 03300 - Cast In Place Concrete.

##### 1.3 REFERENCES

- A. ASTM A 36/A 36M - Structural Steel
- B. ASTM A 123-02 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- C. ASTM A 153-05 - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
- D. ASTM A 450/A 450M-07 - Standard Specification for General Requirements for Carbon and Low Alloy Steel Tubes
- E. ASTM D 1143/D1143M-07 - Standard Test Method for Piles Under Static Axial Compressive Load
- F. ASTM D 3689 - Standard Test Method for Individual Piles Under Static Axial Tensile Load
- G. ASTM D 3966-07 - Standard Test Method for Piles Under Lateral Loads
- H. ANSI/ASME Standard B18.2.1-1996 - Square and Hex Bolts and Screws, Inch Series
- I. OSHA - Excavation Safety Guidelines
- J. ICC - AC358 Acceptance Criteria for Helical Foundation Systems and Devices
- K. ANSI/AWS B2.1-00 - Standard for Welding Procedure and Performance Qualification

##### 1.4 DEFINITIONS

- A. Helical Pile: Manufactured steel foundation with one or more helical bearing plates that is rotated into the ground to support structures.
- B. Helical Anchor: Same as a Helical Pile. Term generally used when axial tension is the primary service load.
- C. Allowable Bearing Capacity: Ultimate bearing capacity of the bearing stratum divided by a factor of safety.
- D. Lead Section: The first section of a Helical Pile or Helical Anchor to enter the ground. Lead



Sections consist of a central shaft with a tapered end and one or more helical bearing plates affixed to the shaft.

- E. Extension Section: Helical Pile or Helical Anchor sections that follow the Lead Section into the ground and extend the Helical Lead to the appropriate depth. Extension Sections consist of a central shaft and may have helical bearing plates affixed to the shaft.
- F. Brackets: Cap plate, angle, thread bar, or other termination device that is bolted or welded to the end of a Helical Pile or Helical Anchor after completion of installation to facilitate attachment to structures or embedment in cast-in-place concrete.
- G. Augering: Rotation of the shaft with little or no advancement. It can occur when the helical bearing plates pass from a relatively soft material into a comparatively hard material. Augering can also result from insufficient crowd or downward pressure during installation. In some cases, augering may be (temporarily) necessary in order to grind through an obstruction.
- H. Installer's Field Engineer: Installer's Field Engineer responsible for the installation and monitoring of helical piles, helical anchors, and brackets.

#### 1.5 DESIGN / PERFORMANCE REQUIREMENTS

- A. Provide the number and size of helical bearing plates for the foundation as required to obtain the 14 kip pile capacity.

#### 1.6 MEASUREMENT AND PAYMENT

- A. Helical Piles, Helical Anchors and Bracket Assemblies: Design quantity determined by the number of piles and anchors indicated in the plans and included in the lump sum price bid for the building and structural.

#### 1.7 SUBMITTALS

- A. 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. Installation methods.
- B. Helical Pile Design: Provide helical pile design calculations to meet the specified loading conditions. Calculations are to be signed and sealed by a New Jersey Professional Engineer.
- C. Shop Drawings: Shop Drawings shall include the following for each pile and anchor:
  - 1. Helical Pile and Helical Anchor product identification number(s) and designation(s).
  - 2. Maximum allowable mechanical compression and tensile strength of the Helical Piles and Helical Anchors.
  - 3. Number of Helical Piles and Helical Anchors and respective design allowable capacities from the Drawings.
  - 4. Planned installation depth and the number of lead and extension sections required.
  - 5. Preliminary helical configuration including number and diameter of helical bearing plates.
  - 6. Manufacturer's recommended capacity to installation torque ratio.
  - 7. Minimum final installation torque.
  - 8. Product identification numbers and designations for all Bracket Assemblies and

- number and size of connection bolts or concrete reinforcing steel details.
- 9. Corrosion protection coating for use on Helical Piles, Helical Anchors, and Bracket Assemblies.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Closeout Submittals: Record actual locations of piles, pile diameter, and pile length.

## 1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products of this section with minimum 10 years documented experience. Company shall also have a current ISO 9001:2008 certification.

B. Installer Qualifications: Company specializing in performing the Work of this section with minimum 5 years documented experience with projects of similar size and complexity.

C. Installer's Field Engineer shall also monitor pile and anchor placement and elevations as specified.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store Helical Piles, Helical Anchors, and Bracket Assemblies on wood pallets or supports to keep from contacting the ground.

## 1.10 SEQUENCING

A. Ensure that information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## 1.11 PROJECT CONDITIONS

A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## 1.12 WARRANTY

A. Provide manufacturer's guarantee for a period of 10 years from date of substantial completion against defects due to manufacturing of helical anchors, helical piles, and bracket assemblies.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Chance Civil Construction

B. Substitutions: Or Equal.

## 2.2 HELICAL PILES AND ANCHORS

- A. Installation Load Capacity = 14 Ton = 28 Kips  
Load Capacity = 7 Ton = 14 Kips  
Round Shaft Helical Pile  
Length = 20'-0"  
Provide Load Capacity Test
- B. Design strength of the helical bearing plates, shaft connections, brackets, and the pile shaft shall be sufficient to support the design loads indicated on the Drawings plus appropriate service load factors. Helical Piles and Helical Anchors shall be manufactured to the following criteria.
1. Central Shaft: 2.875 inch diameter round high strength structural steel tube, with minimum wall thickness of 0.276 inches (Schedule 80) meeting the requirements of ASTM A500.
  2. Helical Bearing Plates: Helical bearing plates of 8, 10, and 12 inches nominal dimension, shall be attached to central shafts by fillet welds continuous on top and bottom and around the leading edges. Helical bearing plates shall be cold pressed into a near perfect helical shape that when affixed to the central shaft are perpendicular with the central shaft, of uniform pitch, and such that the leading and trailing edges are within 3/8 inch of parallel. Average helical pitch shall be plus or minus 1/4 inch of the thickness of the helical bearing plate plus 3 inches. Plate steel for helixes shall meet or exceed ASTM A572, Grade 50.
  3. Corrosion Protection: Helical Piles, Helical Anchors, and Brackets shall be protected as follows:
    - a. Hot-dip galvanized meeting the requirements ASTM A 123 or A 153 as applicable.
  4. Shaft Connections: Helical Pile and Helical Anchor shaft connections shall consist of an external sleeve connection or a welded connection. External sleeve connections shall be in-line, straight and rigid with a maximum tolerable slack of 1/16 inch. Welded connections shall consist of a full penetration groove weld all-around the central shaft. Shaft connections shall have a flexural strength at least as great as the shaft itself.
  5. Bolts: External sleeve connections for 2.875 inch O.D. shafts shall be made via one, two, or three bolts, respectively. Bolts shall be either 7/8, 1, 1-1/4, or 1-1/2 inch diameter as required for strength. Bolts and nuts used to join Helical Pile and Helical Anchor sections at the shaft connections shall be bare steel, epoxy coated, or zinc coated to match the corrosion protection used for the central shaft. Bolts shall be ASME SAE Grade 8 for MH325R piles or ASME SAE Grade 5 for all other piles. All Helical Pile and Helical Anchor bolts shall be securely snug tightened.
  6. Bolt holes through the external sleeve and central shaft shall have a diameter that is 1/16 inch greater than the bolt diameter.
  7. Plug Welds: Alternatively, external sleeve connections may be made using plug welds matching the diameter and number of bolt holes.
  8. External sleeve: External sleeve Helical Pile and Helical Anchor shaft connections shall consist of a high strength structural steel tube outer sleeve meeting the requirements of ASTM A500. Outer sleeve shall be welded to the central shaft with a continuous fillet weld all-around. Fillet weld shall have a throat thickness equal to the external sleeve tube thickness.

- C. Fit Helical Piles and Helical Anchors with a manufactured Bracket that facilitates connection to the structure. Brackets shall be rated for the design loads indicated on the Drawings. Brackets shall be affixed to the end of Helical Piles and Helical Anchors with bolts, plug welds, or continuous penetration welds meeting the design requirements for shaft connections.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until conditions have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.
- C. Protect underground utilities and structures shown on the Drawings. Locate all utilities and structures above and underground in the area of the Work. Determine the exact location of underground utilities and buried structures within a distance from a Helical Pile or Helical Anchor equal to three times the maximum helix diameter.
- D. Immediately notify the Engineer of any condition that would affect proper installation of Helical Piles and Helical Anchors and halt work until the matter can be resolved.

### 3.2 PREPARATION

- A. Excavation if required for proper installation of Helical Piles and Helical Anchors, shall be provided. Shoring and support for excavations greater than 20 feet in depth shall be in strict accordance with OSHA standards shall be designed by a registered design professional specializing in the design of excavations and shoring.
- B. Notify Engineer at least 24 hours prior to installation of Helical Piles or Helical Anchors.

### 3.3 INSTALLATION EQUIPMENT

- A. Installation Equipment: Equipment shall be capable of applying adequate crowd and torque simultaneously to ensure normal advancement of the Helical Piles and Helical Anchors. Equipment shall be capable of maintaining proper alignment and position.
- B. Torque Motor: Use high torque, low RPM torque motors that allow the helical plates to advance with minimal soil disturbance. Motor shall be hydraulic power driven with clockwise and counter-clockwise rotation capability and be adjustable to revolutions per minute during installation. Percussion drilling equipment is not permitted. Torque motor shall have capacity equal to or greater than the minimum final installation torque required. Connection between the torque motor and the installation rig shall have no more than two pivot hinges oriented 90 degrees from each other.
- C. Drive Tool: Connection between the torque motor and Helical Pile and Helical Anchor shall be in-line, straight, and rigid, and consist of a hexagonal, square, or round Kelly bar adapter and helical shaft socket. Drive tool shall be manufactured by the Helical Pile manufacturer and used in accordance with the manufacturer's installation instructions.
- D. Connection Pins: Central shaft of the Helical Pile or Helical Anchor shall be attached to the drive tool by ASME SAE Grade 8 smooth tapered pins matching the number and diameter of the specified shaft connection bolts. Connection pins should be maintained in good condition

and safe to operate at all times. Inspect pins regularly inspected for wear and deformation. Replace with identical pins when worn or damaged.

- E. Torque Indicator: Use a torque indicator to measure installation torque during installation. Torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicator shall be capable of torque measurements with a sensitivity of 500 ft-lb or less. Torque indicators shall be calibrated within 1 year prior to start of Work. Torque indicators that are an integral part of the installation equipment shall be calibrated on-site. Torque indicators mounted in-line with the installation tooling shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be re-calibrated following any maintenance performed on the torque motor. Torque indicators shall be re-calibrated if reasonable doubt exists as to the accuracy of the torque measurements.

### 3.4 INSTALLATION

- A. Install Helical Piles and Helical Anchors in accordance with manufacturer's instructions. Provide the number and size of helical blades to achieve the required torque and tensile/bearing capacity for the soil conditions at the site. The ratio of design load to the total area of the helical bearing plates shall not exceed the Allowable Bearing Capacity.
- B. Connect the lead section to the Torque Motor using the Drive Tool and Connection Pins. Position and align the Lead Section at the location and to the inclination shown on the Drawings and crowd the pilot point into the soil. Advance the Lead Section and continue to add extension sections to achieve the Termination Criteria specified. Advance sections into the soil in a smooth, continuous manner at a rate of rotation between 10 and 40 revolutions per minute. Snug tight all coupling bolts.
- C. Apply constant axial force (crowd) while rotating Helical Piles and Helical Anchors into the ground. The crowd applied shall be sufficient to ensure that the Helical Pile and Helical Anchor advances into the ground a distance equal to at least 80 percent of the blade pitch per revolution during normal advancement.
- D. Manufacturer's torsional strength rating of the Helical Pile or Helical Anchor shall not be exceeded during installation.
- E. Bolt hole elongation due to torsion of the shaft of a Helical Anchor at the drive tool shall be limited to 1/4 inch. Helical Anchors with bolt hole damage exceeding this criterion shall be removed, and discarded.
- F. When the Termination Criteria of a Helical Pile or Helical Anchor is obtained, adjust the elevation of the top end of the shaft to the elevation shown on the Drawings or as required. This adjustment may consist of cutting off the top of the shaft and drilling new holes to facilitate installation of Brackets to the orientation shown on the Drawings. Alternatively, installation may continue until the final elevation and orientation of the pre-drilled bolt holes are in alignment. Do not reverse the direction of torque and back-out the Helical Pile or Helical Anchor to obtain the final elevation.
- G. Install Brackets in accordance with Helical Pile manufacturer's details or as shown on the Drawings.
- H. All Helical Pile and Helical Anchor components including the shaft and Bracket shall be

isolated from making a direct electrical contact with any concrete reinforcing bars or other non-galvanized metal objects since these contacts may alter corrosion rates.

- I. Pre-tension Helical Anchors after installation if indicated on the Drawings.

### 3.5 TERMINATION CRITERIA

- A. Helical Piles and Helical Anchors shall be advanced until the following criteria is satisfied.
  - 1. Minimum depth shall be as shown on the Drawings, that corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater. In addition, Helical Anchors shall be advanced until the average torque over the last 3 feet equals or exceeds the required final installation torque.
- B. If the torsional strength rating of the Helical Pile or Helical Anchor and/or the maximum torque of the installation equipment has been reached or Augering occurs prior to achieving the minimum depth required, exercise one of the following options:
  - 1. Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer.
  - 2. Remove the Helical Pile or Helical Anchor and install a new one with fewer and/or smaller diameter helical bearing plates or with dual cutting edge helical bearing plates. New helical configuration shall be subject to review and acceptance of the Engineer.
  - 3. Remove the Helical Pile or Helical Anchor and pre-drill a 4-inch diameter pilot hole in the same location and reinstall the anchor/pile.
  - 4. If the obstruction is shallow, remove the Helical Pile or Helical Anchor and remove the obstruction by surface excavation. Backfill and compact the resulting excavation and reinstall the anchor/pile.
  - 5. Remove the Helical Pile or Helical Anchor and relocate 1 foot to either side of the installation location subject to the review and acceptance of Architect/Engineer.
  - 6. Reverse the direction of torque, back-out the Helical Pile or Helical Anchor a distance of 1 to 2 feet and attempt to reinstall by decreasing crowd and Augering through the obstruction.
  - 7. Remove the Helical Pile or Helical Anchor and sever the uppermost helical bearing plate from the Lead Section if more than one helical bearing plate is in use, or reshape the helical bearing plates to create a special tapered edge by cutting with a band saw. Reinstall the anchor or pile with revised helical bearing plate configuration.
- C. If the final installation torque is not achieved at the contract length, exercise one of the following options:
  - 1. Until the maximum depth is achieved (if any), install the Helical Pile or Helical Anchor deeper using additional Extension Sections.
  - 2. Remove the Helical Pile or Helical Anchor and install a new one with additional and/or larger diameter helical bearing plates.
  - 3. Decrease the rated load capacity of the Helical Pile or Helical Anchor and install additional Helical Piles or Helical Anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the Engineer.

### 3.6 ALLOWABLE TOLERANCES

- A. Install Helical Piles and Helical Anchors as close to the specified installation and orientation angles as possible. Tolerance for departure from installation and orientation angles shall be

plus or minus 5 degrees.

- B. Install Helical Piles, Helical Anchors, and Bracket Assemblies at the locations and to the elevations shown on the Drawings. Tolerances for Bracket Assembly placement shall be plus or minus 1 inch in both directions perpendicular to the shaft and plus or minus 1/4 inch in a direction parallel with the shaft unless otherwise specified.

### 3.7 QUALITY ASSURANCE

- A. Provide the Engineer with copies of installation records within 48 hours after each installation is completed. Installation records shall include, but are not limited to, the following information:
  1. Name of project and Installer.
  2. Name of Installer's supervisor during installation
  3. Date and time of installation.
  4. Name and model of installation equipment
  5. Type of torque indicator used.
  6. Location of Helical Pile or Helical Anchor by grid location, diagram, or assigned identification number.
  7. Type and configuration of Lead Section with length of shaft and number and size of helical bearing plates.
  8. Type and configuration of Extension Sections with length and number and size of helical bearing plates, if any.
  9. Installation duration and observations.
  10. Total length installed.
  11. Final elevation of top of shaft and cut-off length, if any.
  12. Final plumbness or inclination of shaft.
  13. Installation torque at minimum three-foot depth intervals.
  14. Final installation torque.
  15. Comments pertaining to interruptions, obstructions, or other relevant information.

### 3.8 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

## PART 4 – QUANTITY AND PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part.

END OF SECTION

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
  - b. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
9. Color pigments.
10. Fiber reinforcement.
11. Vapor retarders.
12. Floor and slab treatments.
13. Liquid floor treatments.
14. Curing materials.



- a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
15. Joint fillers.
16. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
  1. Mixture identification.
  2. Minimum 28-day compressive strength.
  3. Durability exposure class.
  4. Maximum w/cm.
  5. Calculated equilibrium unit weight, for lightweight concrete.
  6. Slump limit.
  7. Air content.
  8. Nominal maximum aggregate size.
  9. Steel-fiber reinforcement content.
  10. Synthetic micro-fiber content.
  11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
  13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
  14. Intended placement method.
  15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
  1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
    - a. Location of construction joints is subject to approval of the Engineer.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
  1. Concrete Class designation.
  2. Location within Project.
  3. Exposure Class designation.
  4. Formed Surface Finish designation and final finish.
  5. Final finish for floors.
  6. Curing process.
  7. Floor treatment if any.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
  2. Ready-mixed concrete manufacturer.
  3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Fiber reinforcement.
  4. Curing compounds.
  5. Floor and slab treatments.
  6. Bonding agents.
  7. Adhesives.
  8. Vapor retarders.
  9. Semirigid joint filler.
  10. Joint-filler strips.
  11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
  2. Fly ash.
  3. Slag cement.
  4. Blended hydraulic cement.
  5. Silica fume.
  6. Performance-based hydraulic cement.
  7. Aggregates.
  8. Admixtures:
    - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
  2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
  1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
  1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
  1. Include the following information in each test report:
    - a. Admixture dosage rates.
    - b. Slump.
    - c. Air content.
    - d. Seven-day compressive strength.
    - e. 28-day compressive strength.
    - f. Permeability.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## 1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

### 2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I Type II,.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
  - 7. 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 C494/C494M, Type C.
  - 8. 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.

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 6 mils thick.

## 2.4 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

## 2.5 LIQUID FLOOR TREATMENTS

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

## 2.6 CURING MATERIALS

- A. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ChemMasters, Inc.
    - b. Concrete Sealers USA.
    - c. Kaufman Products, Inc.

## 2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
  - 1. Types I and II, nonload bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.9 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, in accordance with ACI 301.
  1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  1. Fly Ash or Other Pozzolans: 25 percent by mass.
  2. Slag Cement: 50 percent by mass.
  3. Silica Fume: 10 percent by mass.
  4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
  5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with 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 corrosion-inhibiting admixture in concrete mixtures where indicated.
  4. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## 2.10 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
  1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum w/cm: .48
  3. Slump Limit: 4 inches, plus or minus 1 inch.
  4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- B. Class B: Normal-weight concrete used for foundation walls.
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum w/cm: 0.45.
  3. Slump Limit: 4 inches, plus or minus 1 inch.
  4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum w/cm: 0.45.
  3. Slump Limit: 4 inches, plus or minus 1 inch.
  4. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions:



1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
  1. Daily access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
  4. Security and protection for test samples and for testing and inspection equipment at Project site.

### 3.3 TOLERANCES

- A. Comply with ACI 117.

### 3.4 INSTALLATION OF 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.
  1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  3. 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.

### 3.5 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  2. Face laps away from exposed direction of concrete pour.
  3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.

6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
  - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

### 3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. 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. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
  7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
  1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
  - a. Do not use vibrators to transport concrete inside forms.
  - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
  - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
  - d. 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.
  
- F. 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. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.9 FINISHING FORMED SURFACES

#### A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view.
  
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish.
  
3. ACI 301 Surface Finish SF-3.0:

- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/8 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class A.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- B. Rubbed Finish: Apply the following to as cast surface finishes wherever these type of surfaces are shown on the Drawings:
- 1. Smooth-Rubbed Finish:
    - a. Perform no later than one day after form removal.
    - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
    - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
    - d. Maintain required patterns or variances as shown on Drawings.
  - 2. Grout-Cleaned Rubbed Finish:
    - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
    - b. Do not clean concrete surfaces as Work progresses.
    - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
    - d. Wet concrete surfaces.
    - e. 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.
    - f. Maintain required patterns or variances as shown on Drawings.
- C. Related Unformed Surfaces:
- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
  - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.10 FINISHING FLOORS AND SLABS

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

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. 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:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. 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.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
  - a. Slabs on Ground:
    - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and also no more than 1/16 inch in 2 feet.
    - 2) 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.
    - 3) 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.
    - 4) 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.
    - 5) Specified overall values of flatness,  $F_F$  50; and of levelness,  $F_L$  25; with minimum local values of flatness,  $F_F$  40; and of levelness,  $F_L$  17.
  - b. Suspended Slabs:

- 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
  - 2) 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.
  - 3) Specified overall values of flatness,  $F_F$  35; and of levelness,  $F_L$  20; with minimum local values of flatness,  $F_F$  24; and of levelness,  $F_L$  15.
  - 4) 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.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings and/or 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 perpendicular to main traffic route.
1. Coordinate required final finish with Engineer before application.
  2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  2. Coordinate required final finish with Engineer before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
1. Apply in accordance with manufacturer's written instructions and as follows:
    - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
    - b. Tamp aggregate flush with surface, but do not force below surface.
    - c. After broadcasting and tamping, apply float finish.
    - d. 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 in accordance with manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. 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.
  3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
  4. After final floating, apply a trowel finish.
  5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.



### 3.11 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

#### A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. 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:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. 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 concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
  - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - b. Cast anchor-bolt insert into bases.
  - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

#### D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

### 3.12 CONCRETE CURING

#### A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

#### B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
  - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
  - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
    - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
      - a) Lap edges and ends of absorptive cover not less than 12 inches.
      - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
    - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
      - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      - b) Cure for not less than seven days.
    - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

- a) Water.
  - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.

- 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
  - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
  - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
  - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
  - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
  - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Maintain continuity of coating, and repair damage during curing period.
  - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- g. Floors to Receive Curing and Sealing Compound:
- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.13 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
  3. Rinse with water; remove excess material until surface is dry.
  4. Apply a second coat in a similar manner if surface is rough or porous.

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

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  - 1. 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 joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
  - 1. Repair and patch defective areas when approved by Engineer.
  - 2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.
    - e. 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 matches surrounding color.
    - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    - b. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.
  - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
  - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
  - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
  - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
  - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.

- c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. The scheduling and costs for all testing shall be the responsibility of the contractor.
- 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  - 2. Testing agency to immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

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

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
  - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611/C1611M:
  - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
  - a. 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 C1064/C1064M:
  - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
  - a. 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 C31/C31M:
  - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.



- b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.
  - 8. Compressive-Strength Tests: ASTM C39/C39M.
    - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  - 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  - 10. 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
  - 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
  - 12. Additional Tests:
    - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.
      - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
  - 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Engineer.

### 3.17 PROTECTION

- A. Protect concrete surfaces as follows:
  - 1. Protect from petroleum stains.
  - 2. Diaper hydraulic equipment used over concrete surfaces.

3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

#### PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all excavation, shoring, formwork, finishes, steel reinforcement, reinforcement accessories, concrete materials, admixtures, water stops, vapor barriers, treatments, curing materials, joint fillers, bonding agents, adhesives, repair materials, testing, and all related appurtenances as required per the contract documents.

END OF SECTION 033000

## SECTION 033600 - GROUND AND POLISHED CONCRETE

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.
- B. Section Includes:
  - 1. Curing of concrete.
  - 2. Grinding and polishing concrete surfaces.
- C. Related Sections:
  - 1. Division 3 Section “Cast-In-Place Concrete” for general applications of concrete and coordination of sample submittal [and color selection].
  - 2. Division 7 Section “Joint Sealants” for colored sealant for joints.

#### 1.2 REFERENCES

- A. American Concrete Institute (ACI):
  - 1. ACI 301 “Specification for Structural Concrete for Buildings.”
  - 2. ACI 302 IR “Recommended Practice for Concrete Floor and Slab Construction.”
  - 3. ACI 303.1 “Standard Specification for Cast-In-Place Architectural Concrete.”
  - 4. ACI 304 “Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete.”
  - 5. ACI 305R “Recommended Practice for Hot Weather Concreting.”
  - 6. ACI 306R “Recommended Practice for Cold Weather Concreting.”
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM C309 “Liquid Membrane-Forming Compounds for Curing Concrete.”
  - 2. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”
- C. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. AASHTO M194 “Chemical Admixtures.”

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer’s complete technical data sheets for the following:
  - 1. Concrete dye.
  - 2. Curing compound.
- B. Design Mixes: For each type of dye stained concrete.
- C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

- D. Qualification Data: For firms indicated in “Quality Assurance” Article, including list of completed projects.
- F. Product data for each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator, penetrating sealer, and any other chemicals used in the process.
- G. Applicators qualification data.
- H. Polished concrete samples: Size 10 x 10, for each Polished Concrete finish required.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with experience in the production of specified products.
- B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality.
- C. Comply with the requirements of ACI 301.
- D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.
- E. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.
- H. Provide project names, addresses, contact names, phone numbers of at least three (3) projects of similar scope completed by the installer.
- I. Installer/Applicator shall be certified by concrete finish equipment and chemical manufacturer and shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
- J. Manufacturer’s Certification: Provide a letter of acknowledgement from both the equipment and chemical manufacturer stating that the installer is a trained applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.
- K. Ground and Polished Concrete Mockups
  1. Provide under provisions of Division 1 Section -Quality Control.
  2. At location on Project selected by Architect, place and finish 10 feet by 10 feet area.
  3. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
  4. Retain samples of cements, sands, aggregates and other materials used in mockup for comparison with materials used in remaining work.
  5. Aggregate selected must be tested to ensure it will accept polish and be consistent throughout project.

6. Select from Part 4 – Schedules cut and shine level and finish coat.
7. Edges should be included in mockup.
8. Accepted mockup provides visual standard for work of Section.
9. Mockup shall remain through completion of work for use as a quality standard for finished work.
10. Remove mockup when directed.

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L. Environmental Limitations:

1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
2. Flatness and levelness( New Construction)
  - a. Finish concrete shall have a minimum Floor Flatness rating of at least 50.
  - b. Finish concrete shall have a minimum Floor Levelness rating of at least 30.
  - c. Finish concrete shall be cured a minimum of 28 days or at which point equipment can be put on the slab and does not displace aggregate.
3. Application of finish and dye system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
4. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Surface Concrete Dye Stain: Comply with manufacturer's instructions. Deliver dye stain in original, unopened packaging. Store in dry conditions.

1.6 PROJECT CONDITIONS

- A. Concrete Environmental Requirements:
  1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
  2. Avoid placing concrete if rain, snow, or frost is forecast within 24-hours. Protect fresh concrete from moisture and freezing.
  3. Comply with professional practices described in ACI 305R and ACI 306R.
- B. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturer's written recommendations.

1.7 PRE-JOB CONFERENCE

- A. One week prior to placement of mockup a meeting will be held to discuss the Project and application materials.

PART 2 – PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURER

- A. Sika Corporation, Decorative Concrete Division, Aurora, Illinois, (800)- 282-3388.

## 2.2 MATERIALS

### A. Acceptable products:

1. SCOFIELD® Formula One™ Lithium Densifier by Sika Corporation.
2. SCOFIELD® Formula One™ Guard W by Sika Corporation.
3. SCOFIELD® Formula One™ LIQUID DYE CONCENTRATE by Sika Corporation, color designation G388 Soft Gray

### F. Chemical Hardener/Densifiers/Guard Manufactured by Sika Corporation:

1. Materials:
  - a. SCOFIELD® Formula One™- Lithium Densifier is a high performing hardening and dust proofing compound that is chemically reactive and permanently bonds to concrete formulated to be used in conjunction with integrally colored concrete as well as uncolored concrete. (No substitutes)
  - b. SCOFIELD® Guard W is a water based, VOC compliant finish used to longer life and higher reflectivity for Ground and Polished concrete,

### G Equipment

1. 3-head or 4-head counter rotating variable speed floor grinding machine with at least 600 pounds down pressure.
2. Dust extraction system as required by local, state and Federal agencies
3. Grinding heads:
  - a. Metal bonded 16, 25, 40, 60, 80, 150 and 300 grits.
  - b. Resin bonded, phenolic diamonds, 100, 200, 400, 800 , higher grits if needed.
4. Grinding pads for edges:
  - a. 40, 60, 100 and 120 grits.
  - b. 200, 400, 800, 1500 and 3000 grits.
5. Hand grinder with dust extraction equipment and pads.

### G. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:

1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
2. Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that Designer may examine.

## 2.4 CONCRETE MIX DESIGN

- A. Minimum Cement Content: 6 sacks per cubic yard of concrete, 4,000 psi minimum.

- B. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches. If super plasticizers or mid-range water reducers are allowed, slump shall not exceed 8-inches.
- C. Do not add calcium chloride to mix as it causes mottling and surface discoloration.
- D. Supplemental admixtures shall not be used unless approved by manufacturer.
- E. Do not add water to the mix in the field.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Install concrete according to requirements of Division 3 Section “Cast-In-Place Concrete.”
- B. Do not add water to concrete mix in the field.
- C. Surfaces shall be finished uniformly with the following finish:
  1. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.
  2. Ground and Polished Concrete Surface: Precautions should be taken to insure the surface is in tolerances to perform this function.

#### 3.1.1 POLISHED CONCRETE APPLICATION

- A. Applicator shall examine the areas and conditions under which work of this section will be provided and the General Contractor shall correct conditions detrimental to the timely and proper completion of the work and the Applicator shall not proceed until unsatisfactory conditions are resolved.
- B. Apply dye to surface after 400-resin bond grind. Allow dye to dry to touch. After the dye has dried, apply densifier at a rate of 300 square feet per gallon. Using a broom, work the material into the floor for a minimum of 10 minutes. Tight squeegee the remaining material from the floor without leaving squeegee marks or puddles. Allow to cure for 12 – 24 hours.
- C. At either the 200 or 400 grit apply densifier at approximately 200 square feet per gallon using a stiff, long bristled broom. Cover the entire area liberally. Using a broom, work the densifier into the substrate for 30 minutes. During this 30-minute period, continually keep the substrate wet with densifier. Squeegee excess material off the floor. Allow 12 to 24 hours for full cure.
- D. Continue Polishing with progressively finer grits to desired finish level.
- L. Apply Guard W at 750 square feet per gallon.
- M. Using a high speed (2000 – 3000 rpm) burnishing machine and hogs hair burnishing pad, buff the surface to a high shine.

- N. Upon completion, the work shall be ready for final inspection and acceptance by the customer.

### 3.3 CLEANING

- A. The work area shall be kept clean and free of debris at all times.
- B. Remove slurry and dust from adjoining surfaces as necessary.
- C. Dispose of material containers in accordance with local regulations.
- D. Protect finished work until fully cured per manufacturer's recommendations.

## PART 4 – SCHEDULES

### 4.1 CUT AND SHINE LEVELS

- A. Cut Level (Depth of cut)
  - 1. Grade 1 – cream finish
  - 2. Grade 2 – light exposure of course aggregate
  - 3. Grade 3 – heavy exposure of course aggregate
- B. Shine Level
  - 1. Class 1 – 400 grit polish
  - 2. Class 2 – 800 grit polish
  - 3. Class 3 – 1500 grit polish
- C. Polished concrete finish coat
  - 1. At a distance of 100 feet, the floor will reflect images from side lighting.
  - 2. Apply two applications of SCOFIELD® Finish Coat.
- D. Specified for project
  - Grade: 1
  - Class: 1
  - Guard W applications: PER MANUFACTURER RECOMMENDATION

## PART 5 – QUANTITY AND PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part.

END OF SECTION



## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

##### B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and/or Section 099123 "Interior Painting" for painting requirements.

#### 1.2 DEFINITIONS

- ##### A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

#### 1.3 COORDINATION

- ##### A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- ##### B. Coordinate installation of 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.

#### 1.4 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product indicated.
- ##### 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. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
  1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- E. Preinstallation Conference: Conduct conference at Project site.

#### 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 corrosion and deterioration.

1. 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.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
1. ANSI/AISC 303.
  2. ANSI/AISC 341.
  3. ANSI/AISC 360.
  4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
    - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
    - b. Use Load and Resistance Factor Design; data are given at factored-load level.
  2. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
    - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M
- B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M
- C. Plate and Bar: ASTM A36/A36M Retain "Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars" Paragraph below for corrosion-resisting (weathering) structural steel and indicate locations on Drawings.

- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
  - 1. Weight Class: Standard.
  - 2. Finish: Black except where indicated to be galvanized.
- F. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- G. Steel Forgings: ASTM A668/A668M.
- H. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1 (Type 10.9-1), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip zinc coating.
  - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.
- E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable (whichever specified on Drawings).
  - 1. Configuration: Straight or Hooked.
  - 2. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
  - 3. Plate Washers: ASTM A36/A36M carbon steel.
  - 4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
  - 5. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.
- B. Headed Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable (whichever specified on Drawings), straight.
  - 1. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
  - 4. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.
- C. Threaded Rods: ASTM A36/A36M or ASTM A572/A572M, Grade 50 (Grade 345).
  - 1. Nuts: ASTM A63 (ASTM A563M) hex carbon steel.
  - 2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
  - 3. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

## 2.6 SLIDE BEARINGS

- A. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amscot Structural Products Corp.
    - b. Fluorocarbon Company Limited.
    - c. GRM Custom Products.
    - d. R.J. Watson Bridge & Structural Engineered Systems.
    - e. Approved Equivalent.
  - 2. Mating Surfaces: PTFE and PTFE.

3. Coefficient of Friction: Not more than 0.05.
4. Design Load: Not less than 5,000 psi (34 MPa).
5. Total Movement Capability: 2 inches (50 mm).

## 2.7 PRIMER

- A. Steel Primer:
  1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#26.
  1. Etching Cleaner: MPI#25, for galvanized steel.
  2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

## 2.8 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.9 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. 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/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate 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.

## 2.10 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.11 PREFABRICATED BUILDING COLUMNS

- A. Prefabricated building columns, consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Black Rock Fireproof Column, a division of United Steel.
    - b. Dean Lally LLC / FireTrol Columns.
    - c. Approved Equivalent.
- B. Fire-Resistance Ratings: Provide prefabricated building column listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.

1. Fire-Resistance Rating: As indicated on Drawings.

## 2.12 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

## 2.13 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 (50 mm).
  2. Surfaces to be field welded.
  3. Surfaces of high-strength bolted, slip-critical connections.
  4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  5. Galvanized surfaces.
  6. Corrosion-resisting (weathering) steel surfaces.
  7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  1. SSPC-SP 2.
  2. SSPC-SP 3.
  3. SSPC-SP 7 (WAB)/NACE WAB-4.
  4. SSPC-SP 14 (WAB)/NACE WAB-8.
  5. SSPC-SP 11.
  6. SSPC-SP 6 (WAB)/NACE WAB-3.
  7. SSPC-SP 10 (WAB)/NACE WAB-2.
  8. SSPC-SP 5 (WAB)/NACE WAB-1.
  9. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  1. Stripe paint corners, crevices, bolts, welds, and sharp edges.



2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.14 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
  1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E164.
    - d. Radiographic Inspection: ASTM E94/E94M.
  4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
  5. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- 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 on Drawings.
  - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 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 plate before packing with grout.
  - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.5 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

### 3.6 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
  - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

### 3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
  2. Verify weld materials and inspect welds.
  3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94/E94M.
  3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

#### PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of structural steel materials as required per the contract documents. This includes but is not limited to fabrication of structural steel girders and columns, all connections and anchors, priming and galvanizing as required, and erection of all structural steel.

END OF SECTION 051200

## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Roof rafter framing.
5. Ceiling joist framing.

##### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.
16. Sill sealer gasket/termite barrier.

##### B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel trusses.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

#### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

1. AllSteel & Gypsum Products, Inc.

2. CEMCO; California Expanded Metal Products Co.
3. ClarkDietrich.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Manufacturing, Inc.
6. Custom Stud.
7. Design Shapes in Steel.
8. Formetal Co. Inc. (The).
9. Jaimes Industries.
10. MBA Building Supplies.
11. MRI Steel Framing, LLC.
12. Marino\WARE.
13. Mill Steel Framing; Mill Steel Company.
14. Olmar Supply, Inc.
15. Quail Run Building Materials, Inc.
16. SCAFCO Steel Stud Company; Stone Group of Companies.
17. Southeastern Stud & Components, Inc.
18. State Building Products, Inc.
19. Steel Construction Systems; Stone Group of Companies.
20. Steel Network, Inc. (The).
21. Steeler, Inc.
22. Super Stud Building Products Inc.
23. Telling Industries.
24. The Mill Steel Co.
25. United Metal Products, Inc.
26. United Steel Deck, Inc.
27. Approved Equivalent.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel truss framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  1. Design Loads: As indicated on Drawings.
  2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
    - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
    - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
    - d. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
    - e. Floor Joist Framing: Vertical deflection of 1/360 for live loads and 1/240 for total loads of the span.
    - f. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.

- g. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
- 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
- 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
  - a. Upward and downward movement of 1/2 inch (13 mm).
- 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

### 2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S240 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: ST33H (ST230H).
  - 2. Coating: G90 (Z275) or equivalent.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: 50 (340), Class 1.
  - 2. Coating: G90 (Z275).

### 2.4 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-3/8 inches (35 mm).



- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches (32 mm).
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-3/8 inches (35 mm).

## 2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-3/8 inches (35 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-3/8 inches (35 mm).

- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches (32 mm).
  
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications].

## 2.7 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-5/8 inches (41 mm), minimum.

## 2.8 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 1-5/8 inches (41 mm), minimum.

## 2.9 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
  
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Foundation clips.
  - 7. Gusset plates.
  - 8. Stud kickers and knee braces.
  - 9. Joist hangers and end closures.
  - 10. Hole-reinforcing plates.

11. Backer plates.

## 2.10 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.11 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.12 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies' level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-

resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: 24 inches (610 mm).
- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall-framing member and the web of track.
  - 1. Fasten both flanges of studs to top and bottom tracks.
  - 2. Space studs as follows:
    - a. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
  - 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

- I. Install horizontal bridging in stud system, spaced vertically 48 inches (1220 mm). Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
  - 3. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  - 1. Install solid blocking at 96-inch (2440-mm) centers.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Connect vertical deflection clips to studs and anchor to building structure.
  - 3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  - 1. Install solid blocking at 96-inch (2440-mm) centers.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.



### 3.7 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
  - 1. Joist Spacing: 12 inches (305 mm).
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
  - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated, and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.8 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error is not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.9 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

### 3.10 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.11 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

## PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of cold-formed metal framing materials as required per the contract documents. This includes but is not limited to fabrication/installation of cold-formed metal wall and ceiling framing and accessories, along with anchors/clips/fasteners.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Miscellaneous framing and supports.
2. Prefabricated building columns.
3. Shelf angles.
4. Metal ladders.
5. Alternating tread devices.
6. Metal ships' ladders and pipe crossovers.
7. Metal floor plate.
8. Elevator pit sump covers.
9. Structural-steel door frames.
10. Miscellaneous steel trim.
11. Metal bollards.
12. Vehicular barrier cable systems.
13. Pipe and downspout guards.
14. Abrasive metal nosings, treads, and thresholds.
15. Cast-iron wheel guards.
16. Metal downspout boots.
17. Loose bearing and leveling plates.

##### B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

##### C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

#### 1.2 COORDINATION

- ##### A.
- Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### 1.3 ACTION SUBMITTALS

#### A. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Prefabricated building columns.
6. Slotted channel framing.
7. Manufactured metal ladders.
8. Alternating tread devices.
9. Metal ships' ladders and pipe crossovers.
10. Metal bollards.
11. Vehicular barrier cable systems.
12. Pipe and downspout guards.
13. Abrasive metal nosings, treads, and thresholds.
14. Cast-iron wheel guards.
15. Metal downspout boots.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Steel girders for supporting wood frame construction.
5. Steel pipe columns for supporting wood frame construction.
6. Prefabricated building columns.
7. Shelf angles.
8. Metal ladders.
9. Alternating tread devices.
10. Metal ships' ladders and pipe crossovers.
11. Metal floor plate and supports.
12. Elevator pit sump covers.
13. Structural-steel door frames.
14. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
15. Metal bollards.
16. Loose steel lintels.
17. Vehicular barrier cable systems.

- C. Delegated Design Submittals: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.
- E. Delegated design engineer qualifications.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Aluminum Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

#### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- F. Rolled-Stainless Steel Floor Plate: ASTM A793.
- G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IKG.
    - b. Ohio Gratings, Inc.
    - c. SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC.
    - d. Approved Equivalent.
  - 2. Source Limitations: Obtain floor plate from single source from single manufacturer.
- H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- I. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- J. Zinc-Coated Steel Wire Rope: ASTM A741.
  - 1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- K. Stainless Steel Wire Rope: Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.
  - 1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- L. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Galvanized Steel: ASTM A653/A653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.064-inch (1.6-mm) nominal thickness.
  - 3. Cold-Rolled Steel: ASTM A1008/A1008M, structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; hot-dip galvanized after fabrication.
- M. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- N. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

- O. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
- P. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- Q. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- R. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).
- S. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).
- T. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.
- U. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

### 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
  - 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 4000 psi (27 MPa).

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.



- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Provide bearing plates welded to beams where indicated.
  2. Drill or punch girders and plates for field-bolted connections where indicated.
  3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.
- F. Galvanize miscellaneous framing and supports where indicated.

## 2.7 PREFABRICATED BUILDING COLUMNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Black Rock Fireproof Column, a division of United Steel.
  2. Dean Lally LLC / FireTrol Columns.
  3. Approved Equivalent.
- B. Source Limitations: Obtain prefabricated building column from single source from single manufacturer.
- C. General: Provide prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.
- D. Fire-Resistance Ratings: Provide prefabricated building columns listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.
1. Fire-Resistance Rating: As indicated.

## 2.8 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.
  2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.9 METAL LADDERS

### A. General:

- 1. Comply with ANSI A14.3, except for elevator pit ladders.
- 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

### B. Steel Ladders:

- 1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
- 2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
- 3. Rungs: 3/4-inch- (19-mm-) diameter or 3/4-inch- (19-mm-) square, steel bars.
- 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
- 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- 6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) IKG.
    - 2) SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC.
    - 3) Approved Equivalent.
- 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
- 8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- 9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
- 10. Galvanize exterior ladders, including brackets.

### C. Aluminum Ladders:

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

- b. Halliday Products.
  - c. O'Keeffe's Inc.
  - d. Precision Ladders, LLC.
  - e. Royalite Manufacturing, Inc.
  - f. Thompson Fabricating, LLC.
  - g. UPNOVR, Inc.
  - h. Approved Equivalent.
2. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
  3. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
  4. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.
  5. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.
  6. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
  7. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
  8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c.]with welded or bolted aluminum brackets.
  9. Provide minimum 72-inch- (1830-mm-) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

## 2.10 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

- A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
  1. Treads are not to be less than 5 inches (127 mm) exclusive of nosing or less than 8-1/2 inches (216 mm) including the nosing, and riser height is not to be more than 9-1/2 inches (241 mm).
  2. Fabricate ships' ladders and pipe crossovers, including railings from steel, stainless steel or aluminum, as indicated on the Contract Drawings.
  3. Fabricate treads and platforms from welded or pressure-locked steel bar, pressure-locked stainless steel bar, pressure-locked aluminum bar or extruded-aluminum plank grating, as indicated on the Contract Drawings. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
  4. Fabricate treads and platforms from rolled-steel floor, rolled-stainless steel floor, rolled-aluminum-alloy tread or abrasive-surface floor plate, as indicated on the Contract Drawings.
- B. Galvanize exterior steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

## 2.11 METAL FLOOR PLATE

- A. Fabricate from rolled-steel floor, rolled-stainless steel floor, rolled-aluminum-alloy tread or abrasive-surface floor plate of thickness indicated below:
  - 1. Thickness: As indicated.
- B. Provide grating sections where indicated, fabricated from welded or pressure-locked steel bar, pressure-locked stainless steel bar, pressure-locked aluminum bar or extruded-aluminum plank grating. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- C. Provide steel, stainless steel or aluminum angle supports as indicated.
- D. Include steel, stainless steel or aluminum angle stiffeners, and fixed and removable sections as indicated.
- E. Provide flush steel, stainless steel or aluminum bar drop handles for lifting removable sections, one at each end of each section.

## 2.12 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 3/16-inch (4.8-mm) rolled-steel floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.
- B. Provide steel angle supports unless otherwise indicated.

## 2.13 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
  - 1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.
- C. Galvanize exterior steel frames.

## 2.14 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

## 2.15 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe or steel shapes, as indicated.
  - 1. Cap bollards with 1/4-inch-(6.4-mm-) thick, steel plate with flat top.
  - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch-(9.5-mm-) thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
  - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch-(6.4-mm-) thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 80 **steel** pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4-inch (19-mm) steel] machine bolt.
- E. Prime steel bollards with zinc-rich primer.

## 2.16 PIPE AND DOWNSPOUT GUARDS

- A. Fabricate pipe and downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.
- B. Galvanize steel pipe and downspout guards.

## 2.17 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

- A. Cast-Metal Units: Cast iron or aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Safety Tread Co., Inc.
  - b. Balco; a CSW Industrials Company.
  - c. Barry Pattern & Foundry Co., Inc.
  - d. Safe-T-Metal Company, Inc.
  - e. Wooster Products Inc.
  - f. Approved Equivalent.
  
2. Source Limitations: Obtain units from single source from single manufacturer.
3. Cross-hatched nosings, 4 inches (100 mm) wide, with 1/4-inch- (6-mm-) thick 1-inch (25-mm) lip, for casting into concrete.
4. Cross-hatched nosings, 1-1/2 inches (38-mm) wide, 3/8-inch- (9.5-mm-) thick 1-1/2 inch (38-mm) lip, for casting into concrete.
5. Cross-hatched Treads: Full depth of tread with 3/4-by-3/4-inch (19-by-19-mm) nosing, for application over bent plate treads or existing stairs.
6. Fluted-Saddle-Type Thresholds: 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
7. Fluted-Interlocking or -Hook-Strip Thresholds: 5 inches (125 mm) wide by 5/8 inch (16 mm) high, with tapered edge.
8. Thresholds: Plain-stepped- (stop-) type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with 1/2-inch (12-mm) step.
  
- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Safety Tread Co., Inc.
    - b. Amstep Products.
    - c. Armstrong Products, Inc.
    - d. Balco; a CSW Industrials Company.
    - e. Nystrom, Inc.
    - f. Wooster Products Inc.
    - g. Approved Equivalent.
  
  2. Source Limitations: Obtain units from single source from single manufacturer.
  3. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
  4. Nosings:
    - a. Square-back units, 1-7/8 inches (48 mm) or 3 inches (75 mm) wide, for casting into concrete steps.
    - b. Beveled-back units, 3 inches (75 mm) wide with 1-3/8-inch (35-mm) lip, for surface mounting on existing stairs.
    - c. Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete steps.

- 5. Treads: Beveled-back units, full depth of tread with 1-3/8-inch (35-mm) lip, for application over existing stairs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Apply bituminous paint to concealed surfaces of cast-metal units.
- E. Apply clear lacquer to concealed surfaces of extruded units.

#### 2.18 CAST-IRON WHEEL GUARDS

- A. Provide wheel guards made from cast-iron, 3/4-inch- (19-mm-) thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.

#### 2.19 METAL DOWNSPOUT BOOTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. J.R. Hoe & Sons Inc.
  - 2. Neenah Foundry Company.
  - 3. Approved Equivalent.
- B. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- C. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
  - 1. Outlet: Vertical, to discharge into pipe or at 35 degrees from horizontal, to discharge onto splash block or pavement.

#### 2.20 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.

#### 2.21 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.



- C. Galvanize loose steel lintels located in exterior walls.

## 2.22 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.23 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.24 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.25 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

- B. Anchor supports for ceiling-hung toilet partitions, operable partitions and overhead doors securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with expansion anchors or anchor bolts through bolts.
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, "Specifications for Structural Steel Buildings," and with requirements applicable to listing and labeling for fire-resistance rating indicated.

### 3.4 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

### 3.5 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

### 3.6 INSTALLATION OF ALTERNATING TREAD DEVICES

- A. Secure top and bottom of alternating tread devices to construction to comply with manufacturer's written instructions.

### 3.7 INSTALLATION OF METAL SHIPS' LADDERS AND PIPE CROSSOVERS

- A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

- B. Secure pipe crossovers to construction to comply with manufacturer's written instructions.

### 3.8 INSTALLATION OF METAL FLOOR PLATE

- A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

### 3.9 INSTALLATION OF ELEVATOR PIT SUMP COVERS

- A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

### 3.10 INSTALLATION OF STRUCTURAL-STEEL DOOR FRAMES

- A. Fasten structural steel door frames to the floor slab by means of angle clips and expansion bolts. Anchor door jambs to adjacent construction in accordance with shop drawing details.

### 3.11 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

### 3.12 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with expansion anchors or anchor bolts. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
  - 1. Embed anchor bolts at least 4 inches (100 mm) in concrete.
- C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward internal sleeve.

- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch (19-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
  - 1. Do not fill removable bollards with concrete.

### 3.13 INSTALLATION OF PIPE AND DOWNSPOUT GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garages where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

### 3.14 INSTALLATION OF ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

### 3.15 INSTALLATION OF CAST-IRON WHEEL GUARDS

- A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

### 3.16 INSTALLATION OF METAL DOWNSPOUT BOOTS

- A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
- B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

### 3.17 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.18 REPAIRS

#### A. Touchup Painting:

- 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

### PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of miscellaneous metal fabrications as required per the contract documents. This includes but is not limited to all metal materials fasteners, miscellaneous framing/supports, prefabricated building columns, shelf angles, metal ladders, metal floor plates, elevator sump pit covers, structural steel door frames, metal trim, metal bollards, pipe/downspout guards, abrasive metal treads, metal downspout boots, loose steel lintels, and all metal finishes.

END OF SECTION 055000

SECTION 061000  
ROUGH CARPENTRY

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. Framing with dimension lumber.
  - 2. Framing with timbers.
  - 3. Framing with engineered wood products.
  - 4. Wood furring, grounds, nailers, and blocking.
  - 5. Sheathing.
  - 6. Subflooring.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
- B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for the following products:
  - 1. Engineered wood products.
  - 2. Underlayment.
  - 3. Insulating sheathing.
  - 4. Air-infiltration barriers.
- C. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

- D. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
  - 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.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- B. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood product from one source and by a single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
  - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Wood-Preservative-Treated Materials:
    - a. Baxter: J. H. Baxter Co.
    - b. Chemical Specialties, Inc.
    - c. Continental Wood Preservers, Inc.
    - d. Osmose Wood Preserving, Inc.
  - 2. Laminated-Veneer Lumber:
    - a. Alpine Structures.
    - b. Georgia-Pacific Corp.
    - c. Trus Joist MacMillan.
  - 3. Prefabricated Wood I-Joists:
    - a. Trus Joist MacMillan.
    - b. Alpine Structures.
    - c. Georgia-Pacific Corp.



4. Gypsum Sheathing Board:
  - a. Georgia-Pacific Corp.
  - b. National Gypsum Co.; Gold Bond Building Products Division.
  - c. United States Gypsum Co.
5. Air-Infiltration Barriers:
  - a. Celotex Corporation (The); Building Products Division.
  - b. DuPont Company; Fibers Department.

## 2.2 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
  1. NELMA - Northeastern Lumber Manufacturers Association.
  2. NLGA - National Lumber Grades Authority (Canadian).
  3. RIS - Redwood Inspection Service.
  4. SPIB - Southern Pine Inspection Bureau.
  5. WCLIB - West Coast Lumber Inspection Bureau.
  6. WWPA - Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  1. Provide dressed lumber, S4S, unless otherwise indicated.
  2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

## 2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWWA C2 (lumber) and AWWA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
- B. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

## 2.4 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
- B. Non-Load-Bearing Interior Partitions: Provide framing of the following grade and species:
  - 1. Grade: No. 2.
  - 2. Species: Eastern softwoods; NELMA.
  - 3. Species: Northern species; NLGA.
  - 4. Species: Mixed southern pine; SPIB.
  - 5. Species: Western woods; WCLIB or WWPA.
  - 6. Species: Any species above.
- C. Exterior and Load-Bearing Walls: Provide framing of the following grade and species:
  - 1. Grade: No. 2.
  - 2. Species: Hem-fir (north); NLGA..
  - 3. Species: Southern pine; SPIB.
  - 4. Species: Douglas fir-larch; WCLIB or WWPA.
  - 5. Species: Mixed southern pine; SPIB.
  - 6. Species: Spruce-pine-fir; NLGA.
  - 7. Species: Douglas fir-south; WWPA.
  - 8. Species: Hem-fir; WCLIB or WWPA.
  - 9. Species: Douglas fir-larch (north); NLGA.
  - 10. Species: Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  - 11. Species: Any species above.
- D. Framing Other than Non-Load-Bearing Partitions: Provide framing of the following grade and species:
  - 1. Grade: No. 2.
  - 2. Species: Spruce-pine-fir south; NELMA.
  - 3. Species: Hem-fir north; NLGA.
  - 4. Species: Spruce-pine-fir north; NLGA.
  - 5. Species: Mixed southern pine; SPIB.
  - 6. Species: Hem-fir; WCLIB or WWPA.
  - 7. Species: Any species above.

## 2.5 BOARDS

- A. Exposed Boards: Where boards will be exposed in the finished work, provide the following:
  - 1. Moisture Content: 19 percent maximum.
  - 2. Species and Grade: Spruce-pine-fir, C & Btr per WCLIB rules or C Select per NLGA or WWPA rules.
  - 3. As noted on plans by Architect.
- B. Concealed Boards: Where boards will be concealed by other work, provide lumber with 19 percent maximum moisture content and of following species and grade:
  - 1. Species and Grade: Eastern softwoods, No. 3 Common per NELMA rules.

2. Species and Grade: Mixed southern pine, No. 2 per SPIB rules.
3. Species and Grade: Spruce-pine-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
4. Species and Grade: Western woods, Standard per WCLIB rules or No. 3 Common per WWPA rules.
5. Species and Grade: Any species above.

## 2.6 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

## 2.7 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.
  1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Laminated-Veneer Lumber: Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:
  1. Extreme Fiber Stress in Bending: 2500 psi (17 MPa) for 12-inch nominal- (286-mm actual-) depth members.
  2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
  3. Tension Parallel to Grain: 1850 psi (13 MPa).
  4. Compression Parallel to Grain: 2800 psi (19 MPa).
  5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 500 psi (3.5 MPa) and parallel to glue line.
  6. Horizontal Shear: 285 psi (2 MPa) perpendicular to and 190 psi (1.3 MPa) parallel to glue line.

- C. Prefabricated Wood I-Joists: Units manufactured by bonding stress-graded lumber flanges to wood-based structural-use panel webs with exterior-type adhesives complying with ASTM D 2559, to produce I-shaped joists complying with the following requirements:
1. Flange Material: Laminated-veneer lumber.
  2. Web Material: Oriented-strand board (OSB) complying with DOC PS 2.
  3. Web Material: Plywood complying with DOC PS 2.
  4. Web Material: Either material indicated above, as standard with joist manufacturer.
  5. Structural Capacities: Establish and monitor structural capacities according to ASTM D 5055.
  6. Sizes: Depths and widths as indicated, with flanges not less than 1-1/2 inches (38 mm) in actual width.
  7. I-Joists shall be installed with all required anchors, stiffeners and bracing in accordance with manufacturer requirements.
- D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
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. Louisiana-Pacific Corporation.
    - b. Weyerhaeuser Company.
    - c. Or equal.
  2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth members.
  3. Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa).

## 2.8 CONCEALED, PERFORMANCE-RATED STRUCTURAL-USE PANELS

- A. General: Where structural-use panels are indicated for the following concealed types of applications, provide APA-performance-rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail (where applicable).
1. Thickness: Provide panels meeting requirements specified but not less than thickness indicated.
  2. Span Ratings: Provide panels with span ratings required to meet "Code Plus" provisions of APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial."
- B. Subflooring: APA-rated sheathing.
1. Exposure Durability Classification: Exposure 1.
  2. Span Rating: 48/24.
  3. Minimum thickness:  $\frac{3}{4}$  inch.
  4. Floor sheathing shall be tongue and groove and installed with both construction adhesive and required nailing.
- C. Wall Sheathing: APA-rated sheathing.
1. Exposure Durability Classification: Exposure 1.

2. Span Rating: As required to suit stud spacing indicated.
3. Minimum thickness indicated on plan.

D. Roof Sheathing: APA-rated sheathing.

1. Exposure Durability Classification: Exposure 1.
2. Minimum Span Rating: 32/16.
3. Minimum thickness: 5/8 inch.
4. Roof sheathing shall be installed with panel clips.

## 2.9 STRUCTURAL-USE PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch (11.9 mm) thick.

## 2.10 AIR-INFILTRATION BARRIER

- A. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spunbonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:

1. Minimum Thickness: 3 mils (0.08 mm).
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.

## 2.11 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

- B. Nails, Wire, Brads, and Staples: FS FF-N-105.

- C. Power-Driven Fasteners: CABO NER-272.

- D. Wood Screws: ASME B18.6.1.

- E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)

- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

## 2.12 METAL FRAMING ANCHORS

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
  - 1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
  - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.
- C. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
  - 1. Thickness: 0.064 inch (1.6 mm).
- D. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
  - 1. Strap Width: 2 inches (50 mm).
  - 2. Thickness: 0.064 inch (1.6 mm).
- E. Bridging: Rigid, V-section, nail less type, 0.064 inch (1.6 mm) thick, length to suit joist size and spacing.
- F. Rafter Tie-Downs (Hurricane Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-5/8 inches (41 mm) wide by 0.052 inch (1.3 mm) thick minimum. Tie-Downs must be selected to meet uplift forces as calculated in the wood truss design.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWP A M4 to cut surfaces of preservative-treated lumber and plywood.

- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction."
  - 4. "Table 2305.2--Fastening Schedule" of the BOCA National Building Code.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

### 3.2 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Install framing members of size and at spacing indicated.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thickness lumber of same width as framing members.

### 3.3 AIR-INFILTRATION BARRIER

- A. Cover sheathing with air-infiltration barrier as follows:
  - 1. Apply air retarder to comply with manufacturer's written instructions.
  - 2. Apply air-infiltration barrier to cover upstanding flashing with 4-inch (100-mm) overlap.

## PART 4 – QUANTITY AND PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part.

END OF SECTION 06100

## **SECTION 061600 - SHEATHING**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Sheathing joint and penetration treatment.

- B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.



- 1.5 QUALITY ASSURANCE
  - A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
  - B.
- 1.6 DELIVERY, STORAGE, AND HANDLING
  - A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## **PART 2 - PRODUCTS**

- 2.1 PERFORMANCE REQUIREMENTS
  - A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- 2.2 WOOD PANEL PRODUCTS
  - A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
  - B. Factory mark panels to indicate compliance with applicable standard.
- 2.3 PRESERVATIVE-TREATED PLYWOOD
  - A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, .
    - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  - B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
  - C.
  - D. Application: Treat all plywood unless otherwise indicated.
- 2.4 FIRE-RETARDANT-TREATED PLYWOOD
  - A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-

- B. test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- C. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.
  - 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- D. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- E. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- F. Application: Treat all plywood unless otherwise indicated.

## 2.5 WALL SHEATHING

- A. Plywood Sheathing: DOC PS 1, Exposure 1 sheathing.
  - 1. Span Rating: Not less than 16/0.
  - 2. Nominal Thickness: Not less than 1/2 inch (13 mm).
- B. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
  - 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. CertainTeed Corporation.
    - b. Georgia-Pacific Building Products.
    - c. National Gypsum Company.
    - d. United States Gypsum Company.
  - 2. Type and Thickness: Regular, 1/2 inch (13 mm) or Type X, 5/8 inch (15.9 mm) thick.
  - 3. Size: 48 by 96 inches (1219 by 2438 mm). for vertical installation.

## 2.6 PARAPET SHEATHING

- A. Plywood Sheathing: DOC PS 1 Exposure 1 sheathing.
  - 1. Span Rating: Not less than 16/0.

2. Nominal Thickness: Not less than 1/2 inch (13 mm).
- B. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
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. CertainTeed Corporation.
    - b. Georgia-Pacific Building Products.
    - c. National Gypsum Company.
    - d. United States Gypsum Company.
  2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
  3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
  2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

## 2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and

- B. Sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## 2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
  - a. Screw to cold-formed metal framing.
  - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

### 3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION 061600**

## **SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Polyurethane waterproofing.

- B. Related Requirements:

- 1. Section 093013 "Ceramic Tiling" for fluid-applied waterproof membranes beneath ceramic tiles.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

- B. Shop Drawings:

- 1. Show locations and extent of waterproofing.
  - 2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
  - 3. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

- C. Samples: For each exposed product and for each color and texture specified, including the following products:

- 1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
  - 2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).
  - 3. Insulation, 8 by 8 inches (200 by 200 mm).
  - 4. Drainage panel, 4 by 4 inches (100 by 100 mm).

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

#### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
  - 1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
  - 2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

#### 1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
  - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

#### 2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.
  - 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. BASF Corp. - Construction Chemicals.
- b. Carlisle Coatings & Waterproofing Inc.
- c. CETCO, a Minerals Technologies company.
- d. Polyguard Products, Inc.
- e. Tremco Incorporated.

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.
  - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.
- C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
  - 1. Adhesive: Manufacturer's recommended contact adhesive.
- D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
  - 1. Backer Rod: Closed-cell polyethylene foam.

## 2.4 PROTECTION COURSE

- A. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
  - 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. Soprema, Inc.
    - b. W.R. Meadows, Inc.
  - 2. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
  - 3. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer.

## 2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding



No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

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. BASF Corp. - Construction Chemicals.
  - b. Carlisle Coatings & Waterproofing Inc.
  - c. GCP Applied Technologies Inc. (formerly Grace Construction Products).
  - d. Polyguard Products, Inc.

B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate of not less than 2.8 gpm per ft. (35 L/min. per m).

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. BASF Corp. - Construction Chemicals.
  - b. Carlisle Coatings & Waterproofing Inc.
  - c. CETCO, a Minerals Technologies company.
  - d. Polyguard Products, Inc.

## 2.6 INSULATION

A. Board Insulation: Extruded-polystyrene board insulation according to ASTM C 578, square or shiplap edged.

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. DiversiFoam Products.
  - b. Dow Chemical Company (The).
  - c. Owens Corning.
2. Type IV, 25-psi (173-kPa) minimum compressive strength.

## 2.7 INSULATION DRAINAGE PANELS

A. Unfaced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

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. DiversiFoam Products.
- b. Dow Chemical Company (The).
- c. Owens Corning.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
  - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

#### **3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS**

- A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M.

- B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

### 3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
  - 1. Comply with ASTM C 1193 for joint-sealant installation.
  - 2. Apply bond breaker on sealant surface, beneath preparation strip.
  - 3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.
  - 1. Extend sheet flashings onto perpendicular surfaces and items penetrating substrate.

### 3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
  - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm).
  - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
  - 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.
- F. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
  - 1. For horizontal applications, install protection course loose laid over fully cured membrane.
  - 2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
  - 3. Molded-sheet drainage panels may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

### 3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
  - 1. For vertical applications, install board insulation protection course before installing drainage panels.

### 3.7 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

### 3.8 INSULATION DRAINAGE PANEL INSTALLATION

- A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:
  - 1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.
  - 2. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
    - a. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of sheet flashings.
    - b. Flood each area for 24 hours.
    - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

- B. Manufacturer's Field Service: Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.
- C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.
- D. Prepare test and inspection reports.

### 3.10 PROTECTION

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

**END OF SECTION 071416**

## **SECTION 072100 - THERMAL INSULATION**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

##### A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Glass-fiber blanket.

##### B. Related Requirements:

1. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD**

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
  - 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. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

### **2.2 MOLDED POLYSTYRENE FOAM-PLASTIC BOARD**

- A. Molded Polystyrene Board, Type I: ASTM C 578, Type I, 10-psi (69-kPa) minimum compressive strength.
  - 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. Atlas EPS; a Division of Atlas Roofing Corporation.
    - b. DiversiFoam Products.
    - c. Insulfoam-a division of Carlisle Construction Materials Inc.

### **2.3 GLASS-FIBER BLANKET**

- A. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
  - 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. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Owens Corning.

- B. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
  - 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. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Owens Corning.

## 2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 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. AGM Industries, Inc.
    - b. Gemco.
  - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
  - 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. AGM Industries, Inc.
    - b. Gemco.
  - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces.
    - b. Ceiling plenums.
    - c. Attic spaces.
    - d. Where indicated.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.



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. Gemco.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

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. AGM Industries, Inc.

b. Gemco.

## 2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - **EXECUTION**

### 3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) in from exterior walls.

### 3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
  - 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
  - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
  - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

### 3.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

### 3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

- a. Exterior Walls: Set units with facing placed as indicated on Drawings.
- b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

### 3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 072100**

## **SECTION 072500 - WEATHER BARRIERS**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Building wrap.
  - 2. Flexible flashing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

### **PART 2 - PRODUCTS**

#### 2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
  - 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. Dow Chemical Company (The).
    - b. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
    - c. Raven Industries, Inc.
    - d. Reemay, Inc.
  - 2. Water-Vapor Permeance: Not less than 28 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
  - 3. Air Permeance: Not more than 0.001 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
  - 4. Allowable UV Exposure Time: Not less than three months.

5. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

## 2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

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. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
- b. Protecto Wrap Company.
- c. Raven Industries, Inc.

2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.

C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

## PART 3 - EXECUTION

### 3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

B. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

### 3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

**END OF SECTION 072500**

## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Standing-seam metal roof panels.

##### B. Related Sections:

1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.
2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

#### 1.2 PREINSTALLATION MEETINGS

##### A. Preinstallation Conference: Conduct conference at **Haddon Lk Park Pavilion**

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of steel beams during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

##### B. Sustainable Design Submittals:

1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index (SRI) requirements.

2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Manufacturer's Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems
3. Indicate work to be field fabricated or field assembled.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than 10 years of documented experience.
  1. Certified ISO 9001:2015 with Design.
- B. Installer Qualifications: Company with at least three years of documented experience.
  1. MCA Roof Installation Certificate of Completion.
- C. Source Limitations: Obtain all components for roofing system from or approved by roofing system manufacturer.
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.



1. Build mockup of typical roof area and eave, including fascia as indicated on Drawings; including attachments, underlayment and accessories.
2. Build mockups for typical roof area only, including accessories.
  - a. Size: [12 ft. (3.5 m) long by 6 ft. (1.75 m)]
  - b. Each type of exposed seam and seam termination.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels on Project site as recommended by manufacturer to minimize damage, ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels and trims during installation for removal immediately after installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

#### 1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

#### 1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.10 WARRANTY

- A. Product Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: [Two] years from date of Substantial Completion.
- B. Finish Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 30 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Single-source warranty protection.
  2. All trims, accessories, and underlayments included.
  3. Full coverage for materials and labor associated with roof installation.
  4. Periodic evaluations and final roof evaluation written report by manufacturer-authorized third-party roof inspector.
  5. Warranty Period: [20] years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
- B. Solar Reflectance Index (SRI): Not less than **29** when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.
- C. Solar Reflectance Index (SRI): Three-year-aged SRI not less than **32** or initial SRI not less than **39** when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.
- D. Solar Reflectance Index (SRI): Not less than **29** when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.
- E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 15 when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.
- F. "Solar Reflectance Index (SRI)" Paragraph below applies to Green Globes. First option is minimum for roofs with slopes of 2:12 or less; second option is for roofs with slopes steeper than 2:12.Solar

Reflectance Index (SRI): Not less than **29** when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.

- G. Energy Performance: Provide roof panels in accordance with one of the following when tested in accordance with CRRC-1:
1. Three-year, aged solar reflectance of not less than **0.55** and emissivity of not less than **0.75**.
  2. Three-year, aged Solar Reflectance Index (SRI) of not less than **64** when calculated in accordance with ASTM E1980.
- H. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E1592:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: **As indicated on Drawings**.
- I. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested in accordance with ASTM E1680[ **or ASTM E283**] at the following test-pressure difference:
1. Test-Pressure Difference: [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- J. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E1646[ **or ASTM E331**] at the following test-pressure difference:
1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- K. Comply with ANSI/MCA FTS-1-2019, "Test Method for Wind Load Resistance of Flashings Used with Metal Roof Systems."
- L. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating UL 580 and [**UL 30**] [**UL 60**] [**UL 90**] verify the designation as Class vs. UL or with supplemental testing of UL 1897 to failure beyond UL 580 Class 90 designation.
- M. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.

## 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Clipless, Integral-Standing-Seam Metal Roof Panels, Drawings A-221, A-222, A-231: Formed with integral ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using screw fasteners located under concealed side of panels and lapping and interconnecting side edges of adjacent panels.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ATAS International, Inc.; Colonial Seam HCS or comparable product by one of the following:

- a. CENTRIA Architectural Systems.
  - b. IMETCO.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: [**24 Gauge (0.56 mm)**].
    - b. Exterior Finish: Three-coat fluoropolymer
    - c. Color: As selected by Architect from manufacturer's full range <MATTE BLACK>.
  3. Aluminum Sheet: Coil-coated sheet, **ASTM B209 (ASTM B209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
    - a. Thickness: **0.032 inch (0.81 mm)**.
    - b. Surface: Smooth, flat finish.
    - c. Exterior Finish: Three-coat fluoropolymer
    - d. Color: As selected by Architect from manufacturer's full range < MATTE BLACK >.
  4. Panel Coverage: Colonial Seam HCS.
    - a. Seam Height: **1 ½ inch (37.5 mm)**.
    - b. Panel Width: **16.375 inches (416 mm)**.

### 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of **30 mils (0.76 mm)** thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: Stable after testing at **240 deg F (116 deg C)**; ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus **20 deg F (minus 29 deg C)**; ASTM D1970.
  3. Basis-of-Design Product: Subject to compliance with requirements, provide ATAS International, Inc.; ATA-Shield Underlayment or comparable product by one of the following:
    - a. GCP Applied Technologies Inc., Grace Ultra.
    - b. Owens Corning; Titanium PSU30 Roof Underlayment.
    - c. GAF, Tiger Paw Premium Roof Deck Protection
- B. Mechanically Fastened Roofing Underlayment: Provide mechanically fastened roofing underlayment without sealed seams; woven polypropylene with anti-slip polyolefin coating on both sides, minimum thickness 30 mils (.76 mm); meeting or exceeding requirements of ASTM D226/D226M.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide ATAS International, Inc.; ATA-Guard Underlayment or comparable product by one of the following:
    - a. GCP Applied Technologies, Inc., Tri-Flex XT Synthetic Underlayment.
    - b. Owens Corning, Titanium UDL50.
    - c. GAF, Single-Mate Roof Deck Protection

## 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, **G90 (Z275)** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50 (Class AZM150)** coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide factory-formed components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels. Provide prefabricated, pre-notched, close-fitting components of aluminum in the same color and finish as the roofing panel.
  2. Above Sheathing Ventilation (ASV) Spacer Shims: Polyoxymethylene (engineered thermoplastic) **3/8 inch (9.5 mm)** stackable shims.
  3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide factory-formed flashing and trim formed from same material as metal panels, **144 inches (3658 mm)** minimum, as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from aluminum, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **144-inch (3658-mm)** long sections, of size and metal thickness in accordance with SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of **36 inches (914 mm)** o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E. Downspouts: Formed from aluminum of the same color and finish as roof panels. Fabricate in **144-inch (3658-mm)** long sections, complete with formed elbows and offsets, of size and metal thickness in accordance with SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Roof Curbs: Fabricated from same material as roof panels, [**0.048-inch (1.2-mm)**] **<Insert dimension>** nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of **0.060-inch- (1.52-mm-)** nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
1. Insulate roof curb with **6-inch- (150-mm-)** thick, rigid insulation.
- G. Panel Fasteners:
1. Fasteners: Manufacturer's standard type.
    - a. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.
    - b. Metal-to-Wood Fasteners: Self-tapping wood screws.
    - c. Carbon steel thread with organic long-life coating.
    - d. Exposed Fasteners: Type 304 stainless steel cap head.

2. Encapsulated EPDM Washer: Baked-on, high-performance-compatible, chip-resistant finish to match panel color.
- H. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Exposed Sealant: High-performance elastomeric, clear tri-polymer sealant, as recommended by manufacturer.
  2. Spacer Cubes: High-performance spacer cubes to prevent bottoming out of sealant when fasteners are installed non-curing butyl tape.
  3. Seam Sealant: Factory-applied high-performance, high-solid, non-skinning, non-drying seam sealant formulated for roll-forming application into concealed panel joints.

## 2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Factory-fabricate flashing and trim to comply with manufacturer's written instructions and ANSI/MCA FTS-1-2019, "Test Method for Wind Load Resistance of Flashings Used with Metal Roof Systems" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant.
  5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
- D. No exposed cut edges on seams or panels.

## 2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Wet Chemistry Cleaning and Pretreatment:
1. Use complex chrome-oxide pretreatment.
  2. Use chrome final rinse.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel Panels and Accessories:

1. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
5. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Concealed Finish: Apply manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

E. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Custom Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
5. Custom FEVE Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Exposed Anodized Finish:
  - a. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

F. Stainless Steel Panels and Accessories:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - a. Run grain of directional finishes with long dimension of each piece.
  - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

- c. Directional Satin Finish: ASTM A480/A480M No. 4.
  - 3. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.
- G. Copper Panels and Accessories:
- 1. Prepatination: Factory prepatinate in accordance with ASTM B882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
  - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

### 3.3 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated **on Drawings**, wrinkle free, in shingle fashion to shed water, and with end laps of not less than **6 inches (152 mm)** staggered **24 inches (610 mm)** between courses. Overlap side edges not less than **3-1/2 inches (90 mm)**. [**Extend underlayment into gutter trough.**] Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply over the entire roof surface.
  - 2. Apply over the roof area indicated below:
    - a. Roof perimeter for a distance up from eaves of **24 inches (610 mm)** beyond interior wall line.



- b. Valleys, from lowest point to highest point, for a distance on each side of [**18 inches (460 mm)**]. Overlap ends of sheets not less than **6 inches (152 mm)**.
- c. Rake edges for a distance of [**18 inches (460 mm)**]
- d. Hips and ridges for a distance on each side of [**12 inches (305 mm)**]
- e. Roof-to-wall intersections for a distance from wall of [**18 inches (460 mm)**]

### 3.4 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

- A. Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Remove protective film from surface of roof panels and trims immediately prior to installation.
  - 5. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 6. Install flashing and trim as metal panel work proceeds.
  - 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 8. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 9. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
  - 2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
  - 3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
  - 4. Stainless Steel Panels: Use stainless steel fasteners.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners in accordance with manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  - 4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 5. Watertight Installation:

- a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
  - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  - c. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.
  
- F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.
  
- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
  
- H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **12 ft. (3.66 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
  
- I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
  
- J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Connect downspouts to underground drainage system indicated.
  
- K. Roof Curbs: Install flashing around bases where they meet metal roof panels.
  
- L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of **1/4 inch in 20 ft. (6 mm in 6 m)** on slope and location lines as indicated and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

## **SECTION 074646 - FIBER-CEMENT PANELS**

### **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 fiber-cement siding and soffit.
- B. Related Requirements:
  - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, grounds, nailers, and blocking.
  - 2. Section 072500 "Weather Barriers" for weather-resistive barriers.

#### 1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For fiber-cement siding and soffit including related accessories.
- C. Samples for Verification: For each type, color, texture, and pattern required.
  - 1. 12-inch- (300-mm-) long-by-actual-width Sample of siding.
  - 2. 12-inch- (300-mm-) long-by-actual-width Sample of soffit.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding and soffit.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish full lengths of fiber-cement siding and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

#### 1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockups for fiber-cement siding and soffit including accessories.
    - a. Size: 48 inches (1200 mm) long by 60 inches (1800 mm) high.
    - b. Include outside corner on one end of mockup and inside corner on other end.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

### **2.2 FIBER-CEMENT SIDING TYPE A**

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
  - 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. Nichiha Fiber Cement.- VintageWood- BASIS OF DESIGN
    - b. CertainTeed Corporation.
    - c. GAF Materials Corporation.
    - d. James Hardie Building Products, Inc.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/8 inch (16 mm).
- D. Dimensions - AWP-3030: 17-7/8" (455mm) (h) x 119-5/16" (3,030 mm) (l).
  - 1. Texture: Wood plank texture with three, 3/8" grooves running lengthwise, spaced 5-5/8" apart.
  - 2. Color: **ASH** (panel and profile)
- E. Accessory/Component Options:
  - 1. Manufactured Corners with 3-1/2" returns for each profile color.
  - 2. Aluminum trim to be painted per finish schedule.
- F. Factory sealed on six [6] sides.

### **2.3 FIBER-CEMENT SOFFIT**

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
  - 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. Nichiha Fiber Cement.
    - b. CertainTeed Corporation.
    - c. James Hardie Building Products, Inc.
    - d. Norandex Building Materials Distribution, Inc.
- B. Nominal Thickness: Not less than 5/16 inch (8 mm).
- C. Pattern: 12-inch- (300-mm-) wide sheets with smooth texture.

- D. Ventilation: Provide perforated soffit.
- E. Factory Priming: Manufacturer's standard acrylic primer.

## 2.4 INSTALLATION COMPONENTS (NICHIIHA – BASIS OF DESIGN)

### A. Ultimate Clip System:

1. Starter Track:
  - a. Horizontal Panel Installations - FA 700 – 3,030mm (l) galvalume coated steel.
  - b. Vertical Panel Installations (AWP-3030 only) – FA 710T – 3,030mm (l) galvalume.
2. Panel Clips: JEL 777 “Ultimate Clip” (10mm rainscreen for 16mm AWP) – Zinc- Aluminum- Magnesium alloy coated steel.
  - a. Joint Tab Attachments– used at all AWP-1818 panel to panel vertical joints – NOT used with AWP-3030 installations.
3. Single Flange Sealant Backer – FHK 1017 (10mm) – 6.5’ (l) fluorine coated galvalume.
4. Double Flange Sealant Backer – FH 1020 (10mm) – 10’ (l) fluorine coated galvalume.
5. Corrugated Spacer – FS 1005 (5mm), FS 1010 (10mm) – 4’ (l).
6. Finish Clip (optional) – JE310 (5mm)

### B. Aluminum Trim (optional): Paint as specified in finish schedule.

### C. Essential Flashing System:

1. Starter – main segments (3,030mm), inside corners, outside corners
2. Compression Joint – main segments (3,030mm)
3. Overhang – main segments (3,030mm), inside corners, outside corners, joint clips

### D. Fasteners: Corrosion resistant fasteners, such as hot-dipped galvanized screws appropriate to local building codes and practices must be used. Use Stainless Steel fasteners in high humidity and high-moisture regions. Panel manufacturer is not liable for corrosion resistance of fasteners. Do not use aluminum fasteners, staples or fasteners that are not rated or designed for intended use. See manufacturer’s instructions for appropriate fasteners for construction method used.

### E. Flashing: Flash all areas specified in manufacturer’s instructions. Do not use raw aluminum flashing. Flashing must be galvanized, anodized, or PVC coated.

### F. Sealant: Sealant shall comply with ASTM C920, Class 35.

## 2.5 ACCESSORIES

### A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

### B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Corner posts.
2. Door and window casings.
3. Fasciae.
4. Moldings and trim.

- C. Insect Screening for Soffit Vents: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh.
- D. Continuous Soffit Vents: Aluminum, hat-channel shape, with perforations; 2 inches (51 mm) wide and not less than 96 inches (2438 mm) long.
  - 1. Net-Free Area: 8 sq. in./linear ft. (560 sq. cm/m).
  - 2. Finish: as selected by architect.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean substrates of projections and substances detrimental to application.

#### **3.3 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  - 1. Do not install damaged components.
  - 2. Install fasteners no more than 24 inches (600 mm) o.c.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

#### **3.4 ADJUSTING AND CLEANING**

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

**END OF SECTION 074646**



## **SECTION 076200 - SHEET METAL FLASHING AND TRIM**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Manufactured through-wall flashing with counterflashing.
2. Manufactured reglets with counterflashing.
3. Formed roof-drainage sheet metal fabrications.
4. Formed low-slope roof sheet metal fabrications.
5. Formed wall sheet metal fabrications.
6. Preformed metal drip edge.

- B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

#### 1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
  3. Review requirements for insurance and certificates if applicable.
  4. Review sheet metal flashing observation and repair procedures after flashing installation.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches(1:10).

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory- applied finishes.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

## 1.9 DELIVERY, STORAGE, AND HANDLING

### **SHEET METAL FLASHING AND TRIM**

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

#### 1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

#### 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. As-Milled Finish: Standard two-side bright.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70

percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
1. Finish: 2D (dull, cold rolled).
- D. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275) prepainted by coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: Smooth, flat
  2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    3. Color: As selected by Architect from manufacturer's full range.
    4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- E. Zinc Sheet: 99.995 percent electrolytic high-grade zinc with alloy additives of copper (0.08 to 0.20 percent), titanium (0.07 to 0.12 percent), and aluminum (0.015 percent); with manufacturer's standard factory-applied, flexible, protective back coating.
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. Jarden Zinc Products.
    - b. Rheinzink America Inc.
    - c. Umicore Building Products USA, Inc.
  2. Finish: Bright rolled.

### 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
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. Atlas Roofing Corporation.
    - b. Engineered Coated Products.

- c. SDP Advanced Polymer Products Inc.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS- modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
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. Carlisle Coatings & Waterproofing Inc.
    - b. GCP Applied Technologies Inc. (formerly Grace Construction Products).
    - c. Henry Company.
    - d. Owens Corning.
    - e. Polyguard Products, Inc.
    - f. SDP Advanced Polymer Products Inc.
  2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
  3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

#### 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Copper, Zinc-Tin Alloy-Coated Copper, Copper-Clad Stainless-Steel Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
  3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  5. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.
  6. Fasteners for Zinc-Coated (Galvanized) Aluminum-Zinc Alloy-Coated Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
  7. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
1. For Copper or Copper-Clad Stainless Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50

- percent lead.
  - 2. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  - 3. For Zinc-Tin Alloy-Coated Stainless Steel or Copper: ASTM B 32, 100 percent tin, with maximum lead content of 0.2 percent, as recommended by sheet metal manufacturer.
  - 4. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
  - 5. For Zinc: ASTM B 32, 40 percent tin and 60 percent lead with low antimony, as recommended by zinc manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
  - E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
  - F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
  - G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
  - H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
  - I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch (75-mm) intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with interlocking counterflashing on exterior face, of same metal as flashing.
  - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
    - 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) Cheney Flashing Company.
      - 2) Hohmann & Barnard, Inc.
      - 3) Keystone Flashing Company, Inc.
- B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and welded corners and junctions.
  - 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. Cheney Flashing Company.
    - b. Fry Reglet Corporation.
    - c. Heckmann Building Products, Inc.
    - d. Hohmann & Barnard, Inc.
    - e. Keystone Flashing Company, Inc.
  - 2. Material: Aluminum, 0.024 inch (0.61 mm) thick.
  - 3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  - 4. Accessories:

- a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
  - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
5. Finish: With manufacturer's standard color coating.

## 2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  2. Obtain field measurements for accurate fit before shop fabrication.
  3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- G. Do not use graphite pencils to mark metal surfaces.

## 2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
1. Gutter Profile: Rectangular, See Drawings.
  2. Expansion Joints: Built in.

3. Accessories: Wire-ball downspout strainer.
  - a. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials: Aluminum: 0.032 inch (0.81 mm) thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
  1. Fabricated Hanger Style: Fig 1-35C according to SMACNA's "Architectural Sheet Metal Manual."
  2. Fabricate from the following materials:
    - a. Aluminum: 0.024 inch (0.61 mm) thick.
- C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:
  1. Aluminum: 0.032 inch (0.81 mm) thick.
- D. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
  1. Aluminum: 0.040 inch (1.02 mm) thick.

## 2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
  1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
  2. Fabricate with scuppers spaced 10 feet (3 m) apart, to dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  3. Fabricate from the Following Materials:
    - a. Aluminum: 0.050 inch (1.27 mm) thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.
  1. Coping Profile: See Drawings .
  2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
  3. Fabricate from the Following Materials:
    - a. Aluminum: 0.050 inch (1.27 mm) thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  1. Aluminum: 0.040 inch (1.02 mm) thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  1. Aluminum: 0.032 inch (0.81 mm) thick.
- E. Flashing Receivers: Fabricate from the following materials:



1. Aluminum: 0.032 inch (0.81 mm) thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

G. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## 2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: [0.022 inch] thick.
2. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] thick.
3. Aluminum: [0.032 inch] thick.
4. Stainless Steel: [0.0156 inch] thick.
5. Copper: [16 oz./sq. ft.].
6. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.].
7. Zinc: [0.032 inch] [0.039 inch] thick.
8. Copper-Clad Stainless Steel: [0.016 inch] thick.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

### 3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime

## **SHEET METAL FLASHING AND TRIM**

substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

- D. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  - 5. Torch cutting of sheet metal flashing and trim is not permitted.
  - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
  - 1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws but not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
  - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
  2. Do not pre-tin zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.
  3. Do not use torches for soldering.
  4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
  5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
  6. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
  7. Copper-Clad Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.
- H. Rivets: Rivet joints in uncoated aluminum and zinc where necessary for strength.

### 3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
  2. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
  3. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
  2. Connect downspouts to underground drainage system.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.
- E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
- F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

### 3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed

fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
  - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

### 3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Reglets: Installation of reglets is specified in Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry."
- D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

### 3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

## SHEET METAL FLASHING AND TRIM

- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 076200**

## **SECTION 088000 - GLAZING**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Glass for windows, doors, storefront framing, and glazed curtain walls.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 084126 "All-Glass Entrances and Storefronts."
  - 2. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for glazing sealants used in structural-sealant-glazed curtain walls.
  - 3. Section 088113 "Decorative Glass Glazing."

#### 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### 1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
  - 1. Tinted glass.
  - 2. Coated glass.

3. Insulating glass.
4. Spandrel Glass

- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units, glass testing agency and sealant testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For tinted glass, coated glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.
  1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

## 1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### 2.1 MANUFACTURERS

- 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 Vitro Architectural Glass; Solarban Series:
  - 1. Guardian Industries Corp.; SunGuard.- BASIS OF DESIGN
  - 2. JE Berkowitz, LP.
  - 3. Oldcastle BuildingEnvelope™.
  - 4. Pilkington North America.
  - 5. Vetrotech Saint-Gobain.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  - 1. Obtain tinted glass from single source from single manufacturer.
  - 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.



## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
  - 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
  - 2. For laminated-glass lites, properties are based on products of construction indicated.
  - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  - 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
  - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- E. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."
- F. Reflective-Coated Vision Glass: ASTM C 1376.
- G. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.
- H. Silicone-Coated Spandrel Glass: ASTM C 1048, Type I, Condition C, Quality-Q3.
- I. Reflective-Coated Spandrel Glass: ASTM C 1376, Kind CS.

## 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.6 GLAZING SEALANTS

### A. General:

1. **Compatibility:** Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. **Suitability:** Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. **Colors of Exposed Glazing Sealants:** As selected by Architect from manufacturer's full range.

### B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

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. Dow Corning Corporation.
  - b. Pecora Corporation.
  - c. Sika Corporation.
  - d. Tremco Incorporated.
2. **Applications: Use O Glazing Substrates:** Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.

### C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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. Dow Corning Corporation.
  - b. Pecora Corporation.
  - c. Sika Corporation.
  - d. Tremco Incorporated.
2. **Applications: Use O Glazing Substrates:** Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.

### D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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. Dow Corning Corporation.
    - b. Pecora Corporation.
    - c. Sika Corporation.
    - d. Tremco Incorporated.
  2. Applications: Coated glass, color anodic aluminum, aluminum coated with a high- performance coating, galvanized steel, and wood.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
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. Dow Corning Corporation.
    - b. Pecora Corporation.
    - c. Sika Corporation.
    - d. Tremco Incorporated.
  2. Applications: Use O Glazing Substrates: Coated glass, color anodic aluminum, and aluminum coated with a high-performance coating.

## 2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers

and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### 3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear fully tempered float glass.
  - 1. Minimum Thickness: 6 mm or as indicated on Drawings.
  - 2. Safety glazing required.

### 3.9 INSULATING GLASS SCHEDULE

- A. Low-E Insulating Glass: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:
  - 1. Products: Provide the following:
    - a. Basis of Design: Vitro Architectural Glass; Solarban 60 & Solarban 67, see elevations and window schedule. – Tint Bronze
  - 2. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outdoor Lite: Annealed float glass.
  - 5. Interspace Content: Air.
  - 6. Indoor Lite: Annealed float glass.
  - 7. Low-E Coating: Sputtered on second surface.
  - 8. Winter Nighttime U-Factor: 0.29 maximum.
  - 9. Summer Daytime U-Factor: 0.27 maximum.
  - 10. Visible Light Transmittance: 48 percent minimum.



11. Solar Heat Gain Coefficient: 0.60 maximum.
12. Safety glazing required.

B. Glass Type: Ceramic-coated, tinted, insulating spandrel glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 60
2. Coating Color: [As selected by Architect from manufacturer's full range]
3. Overall Unit Thickness: 1 inch
4. Minimum Thickness of Each Glass Lite: 6 mm
5. Outdoor Lite: Tinted annealed float glass.
6. Tint Color: Bronze.
7. Interspace Content: Air.
8. Indoor Lite: Clear annealed float glass.
9. Coating Location: Fourth surface.
10. Winter Nighttime U-Factor: <Insert value> maximum.
11. Summer Daytime U-Factor: <Insert value> maximum.

C. Glass Type: Reflective-coated, insulating glass

1. Basis-of-Design Product: Vitro Architectural Glass; Solarcool Solarbronze with Solarban Low-E coatings.
2. Kind: Kind CV (coated vision glass) except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m)].
3. Coating Type: Sputter-coating (vacuum deposition process).
4. Coating Color: Pewter.
5. Overall Unit Thickness: 1 inch (25 mm).
6. Minimum Thickness of Each Glass Lite: 6 mm.
7. Outdoor Lite: Tinted float glass.
8. Tint Color: Bronze.
9. Interspace Content: Air.
10. Indoor Lite: Clear annealed float glass.
11. Coating Location: Second surface.
12. Outdoor Visible Reflectance: 21 percent maximum.
13. Winter Nighttime U-Factor: 0.47 maximum.
14. Summer Daytime U-Factor: 0.50 maximum.
15. Visible Light Transmittance: 16 percent minimum.
16. Solar Heat Gain Coefficient: 0.34 maximum.
17. Low-Maintenance Coating: Pyrolytic coating on first surface.
18. Safety glazing required.

**END OF SECTION 088000**

## **SECTION 092216 - NON-STRUCTURAL METAL FRAMING**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

##### A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

##### B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 10 lbf/sq. ft. (480 Pa).

## 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
1. Steel Studs and Runners:
    - 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) CEMCO; California Expanded Metal Products Co.
      - 2) MarinoWARE.
      - 3) MBA Building Supplies.
      - 4) MRI Steel Framing, LLC.
      - 5) SCAFCO Steel Stud Company.
    - b. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm) or as indicated on Drawings.
    - c. Depth: 3-5/8 inches (92 mm), 6 inches (152 mm), 2-1/2 inches (64 mm), or 1-5/8 inches (41 mm) as indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
  2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. 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) CEMCO; California Expanded Metal Products Co.
      - 2) ClarkDietrich Building Systems.
      - 3) MarinoWARE.
      - 4) MBA Building Supplies.
      - 5) SCAFCO Steel Stud Company.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. 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. CEMCO; California Expanded Metal Products Co.
  - b. ClarkDietrich Building Systems.
  - c. MarinoWARE.
  - d. SCAFCO Steel Stud Company.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 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. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. SCAFCO Steel Stud Company.
  - 2. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm) or as indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide 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. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. SCAFCO Steel Stud Company.
  - 2. Depth: 1-1/2 inches (38 mm) or as indicated on Drawings.
  - 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 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. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. SCAFCO Steel Stud Company.
  - 2. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm) or as indicated on Drawings.
  - 3. Depth: 7/8 inch (22.2 mm) or 1-1/2 inches (38 mm) or as indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
  - 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. ClarkDietrich Building Systems.
    - b. MarinoWARE.

- c. SCAFCO Steel Stud Company.
  - 2. Configuration: Asymmetrical or hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: 3/4 inch (19 mm) or as indicated on Drawings.
  - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated- steel thickness of 0.0329 inch (0.8 mm).
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.
  - 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. ClarkDietrich Building Systems.
    - b. MarinoWARE.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
  - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: 1-1/2 inches (38 mm) or as indicated on Drawings .
- D. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
  - 2. Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm) or as indicated on Drawings.

- b. Depth: 1-5/8 inches (41 mm), 2-1/2 inches (64 mm), 3-5/8 inches (92 mm) or as indicated on Drawings.
- 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
  - a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm or as indicated on Drawings).
- 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
  - a. Configuration: Asymmetrical or hat shaped.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

## PART 3 - **EXECUTION**

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
  2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
  3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.

- b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
- 1. Screw to wood framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Z-Shaped Furring Members:
- 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches (1219 mm) o.c.
  - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
  - 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.



- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION 092216**

## **SECTION 092900 - GYPSUM BOARD**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

##### A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

##### B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

#### 1.3 ACTION SUBMITTALS

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

- B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### **2.2 GYPSUM BOARD, GENERAL**

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### **2.3 INTERIOR GYPSUM BOARD**

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
  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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. National Gypsum Company.
    - e. United States Gypsum Company.
  2. Thickness: 1/2 inch (12.7 mm).
  3. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. National Gypsum Company.
    - e. United States Gypsum Company.
  2. Thickness: 5/8 inch (15.9 mm).
  3. Long Edges: Tapered.

- C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. 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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. National Gypsum Company.
    - e. United States Gypsum Company
  2. Thickness: 1/4 inch (6.4 mm).
  3. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. National Gypsum Company.
    - e. United States Gypsum Company
  2. Thickness: 1/2 inch (12.7 mm).
  3. Long Edges: Tapered.
- E. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. National Gypsum Company.
    - e. United States Gypsum Company.
  2. Core: 1/2 inch (12.7 mm), regular type or 5/8 inch (15.9 mm), Type X.
  3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
  4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
  5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
  6. Long Edges: Tapered.
  7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- F. Impact-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

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 Gypsum.
  - b. CertainTeed Corporation.
  - c. Georgia-Pacific Building Products.
  - d. National Gypsum Company.
  - e. United States Gypsum Company.
2. Core: 1/2 inch (12.7 mm), regular type or 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
6. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

G. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

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 Gypsum.
  - b. CertainTeed Corporation.
  - c. Georgia-Pacific Building Products.
  - d. National Gypsum Company.
  - e. United States Gypsum Company.
2. Core: 1/2 inch (12.7 mm), regular type or 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

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. C-Cure.
  - b. CertainTeed Corporation.
  - c. Custom Building Products.
  - d. James Hardie Building Products, Inc.
  - e. National Gypsum Company.
  - f. USG Corporation.
2. Thickness: 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) as indicated on Drawings.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

- B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
  - 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 Gypsum.
    - b. CertainTeed Corporation.
    - c. Continental Building Products, LLC.
    - d. Georgia-Pacific Building Products.
    - e. USG Corporation.
  - 2. Core: 1/2 inch (12.7 mm), regular type or 5/8 inch (15.9 mm), Type X as indicated on Drawings.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
  - 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. Fry Reglet Corporation.
    - b. Gordon Inc.
    - c. Pittcon Industries.
  - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
  - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.

2. Exterior Gypsum Soffit Board: Paper.
  3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  2. Cementitious Backer Units: As recommended by backer unit manufacturer.
  3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

## 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. 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. Accumetric LLC.
  - b. Grabber Construction Products.
  - c. Pecora Corporation.
  - d. Specified Technologies, Inc.
  - e. USG Corporation.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 APPLYING AND FINISHING PANELS, GENERAL**

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  2. Fit gypsum panels around ducts, pipes, and conduits.



3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
  - H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
  - I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
  - J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  1. Wallboard Type: Vertical surfaces unless otherwise indicated.
  2. Type X: Where required for fire-resistance-rated assembly.
  3. Flexible Type: Apply in double layer at curved assemblies.
  4. Ceiling Type: Ceiling surfaces.
  5. Abuse-Resistant Type: As indicated on Drawings.
  6. Impact-Resistant Type: As indicated on Drawings.
  7. Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
  1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm)

minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
  2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

### 3.4 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and locations indicated to receive tile.
- B. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
  1. Unless noted otherwise, provide control joints at 30'-0" on center, maximum in partitions and furring.
  2. Unless noted otherwise, provide control joints at 50'-0" on center and 2,500 sq. ft., maximum in ceilings.

- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. Bullnose Bead: Use at outside corners where indicated.
  - 3. LC-Bead: Use at exposed panel edges.
  - 4. L-Bead: Use where indicated.
  - 5. U-Bead: Use at exposed panel edges and where indicated.
  - 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings.

### 3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile, panels that are substrate for acoustical tile and where indicated on Drawings.
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 092900**

## **SECTION 099123 - INTERIOR PAINTING**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
  - 1. Concrete.
  - 2. Cement board.
  - 3. Concrete masonry units (CMUs).
  - 4. Steel and iron.
  - 5. Galvanized metal.
  - 6. Aluminum (not anodized or otherwise coated).
  - 7. Stainless steel.
  - 8. Wood.
  - 9. Fiberglass.
  - 10. Plastic.
  - 11. Gypsum board.
  - 12. Plaster.
  - 13. Cotton or canvas insulation covering.
  - 14. ASJ insulation covering.
  - 15. Bituminous-coated surfaces.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
  - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
  - 3. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
  - 4. Section 099600 "High-Performance Coatings" for tile-like coatings.
  - 5. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

#### 1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- 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. Benjamin Moore & Co.
2. M.A.B. Paints.
3. Pratt & Lambert.
4. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
5. Sherwin-Williams Company (The).

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

### **2.2 PAINT, GENERAL**

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

- B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

- C. Colors: As selected by Architect from manufacturer's full range.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.

- 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms:
    - a. Uninsulated metal piping.
  - 2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.



- f. Plastic conduit.
  - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Cement Board Substrates:
  - 1. Water-Based Light Industrial Coating System MPI INT 3.3H:
    - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.
- B. CMU Substrates:
  - 1. Water-Based Light Industrial Coating System MPI INT 4.2K:
    - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.
- C. Steel Substrates:
  - 1. Water-Based Light Industrial Coating System MPI INT 5.1B:
    - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
- D. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI INT 5.3B MPI INT 5.3K:
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  
- E. Aluminum (Not Anodized or Otherwise Coated) Substrates:
  1. Water-Based Light Industrial Coating System MPI INT 5.4E:
    - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  
- F. Stainless-Steel Substrates:
  1. Water-Based Light Industrial Coating System MPI INT 5.6A MPI INT 5.6F:
    - a. Prime Coat: Primer, bonding, solvent based, MPI #69.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  
- G. Wood Substrates: Woodtrim Architectural woodwork Doors Windows and wood board paneling.
  1. Water-Based Light Industrial Coating System MPI INT 6.3P:
    - a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  
- H. Wood Substrates: Wood paneling and casework.
  1. High-Performance Architectural Latex System MPI INT 6.4S:
    - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
  
- I. Fiberglass Substrates:
  1. Water-Based Light Industrial Coating System MPI INT 6.7C:
    - a. Prime Coat: Primer, bonding, water based, MPI #17.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.
    - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

J. Plastic Substrates:

1. Water-Based Light Industrial Coating System MPI INT 6.8C:
  - a. Prime Coat: Primer, bonding, solvent based, MPI #69.
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

K. Gypsum Board and Plaster Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
2. Water-Based Light Industrial Coating System MPI INT 9.2L:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

L. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.

1. Institutional Low-Odor/VOC Latex System MPI INT 10.1D:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

M. Bituminous-Coated Substrates:

1. Latex System MPI INT 10.2A:
  - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
  - b. Intermediate Coat: Latex, interior, matching topcoat.
  - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

**END OF SECTION 099123**

## SECTION 08 36 00 SECTIONAL521S SERIES ALUMINUM SECTIONAL OVERHEAD DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Glazed Aluminum Sectional Overhead Doors
- B. Electric Operators and Controls.
- C. Operating Hardware, tracks, and support.

#### 1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Prepared opening in concrete. Execution requirements for placement of anchors in concrete wall construction.
- B. Section 04810 - Unit Masonry Assemblies: Prepared opening in masonry. Execution requirements for placement of anchors in masonry wall construction.
- C. Section 05500 - Metal Fabrications: Steel frame and supports.
- D. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.
- E. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.
- F. Section 08710 - Door Hardware: Cylinder locks.
- G. Section 09900 - Paints and Coatings: Field painting.
- H. Section 11150 - Parking Control Equipment: Remote door control.
- I. Section 16130 - Raceway and Boxes: Empty conduit from control station to door operator.
- J. Section 16150 - Wiring Connections: Electrical service to door operator.

#### 1.3 REFERENCES

- A. [ANSI/DASMA 102](#) - American National Standard Specifications for Sectional Overhead Type Doors.

#### 1.4 DESIGN / PERFORMANCE REQUIREMENTS

- 1. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code. Design pressure of 30PSF, 115 MPH.
- B. Wiring Connections: Requirement for electrical characteristics.
  - 1. 208 volts, single phase, 60 Hz (190-207V range)
  - 2. 208 volts, three phase, 60 Hz (190-207V range)
- C. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

## 1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- 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. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.

## 1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

## **PART 2 PRODUCTS**

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: [www.overheaddoor.com](http://www.overheaddoor.com). E-mail: [sales@overheaddoor.com](mailto:sales@overheaddoor.com).
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

### 2.2 GLAZED ALUMINUM SECTIONAL OVERHEAD DOORS

- A. Glazed Sectional Overhead Doors: 521 Series Aluminum Doors by Overhead Door
- SECTIONAL521S SERIES ALUMINUM SECTIONAL OVERHEAD DOORS

Corporation.

1. Door Assembly: Stile and rail assembly secured with 1/4 inch (6 mm) diameter through rods.
  - a. Panel Thickness: 1-3/4 inches (44 mm).
  - b. Center Stile Width: 2-11/16 inches (68 mm)
  - c. End Stile Width: 3-5/16 inches (84 mm) - 2 Per End
  - d. Intermediate Rail Pair Width: 3-11/16 inches (94 mm).
  - e. Top Rail Width:
    - 1) 3-3/4 inches (95 mm).
  - f. Bottom Rail Width:
    - 1) 4-1/2 inches (114 mm).
  - g. Aluminum Panels: 0.050 inch (1.3 mm) thick, aluminum.
  - h. Stiles and Rails: 6063 - T6 aluminum.
  - i. Glazing:
    - 1) 1/2 inch (12.5 mm) Tempered Insulating glass.
    - 2) 1/2 inch (12.5 mm) Low E Insulated glazing.
2. Finish and Color:
  - a. Powder Coating Finish: Color as selected by Architect from manufacturer's standard colors. MATTE BLACK
3. Windload Design: Provide to meet the Design/Performance requirements specified.
4. Hardware: Galvanized steel hinges and fixtures. Precision bearing rollers with hardened steel races.
5. Lock:
  - a. Interior galvanized single unit with interlock.
6. Weatherstripping:
  - a. Flexible bulb-type strip at bottom section.
  - b. Flexible Jamb seals.
  - c. Flexible Header seal.
7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
8. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is provided with all wiring harnesses needed direct from the factory
  - a. Entrapment Protection: Required for momentary contact or, radio control operation.
    - 1) Wireless electric sensing edge monitored to meet UL 312/2010.
    - 2) Wired electric sensing edge monitored to meet UL 325/2010.
    - 3) Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
    - 4) Built in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
  - b. Operator Controls:
    - 1) Push-button operated control stations with open, close, and stop buttons.
    - 2) Key operated control stations with open, close, and stop buttons.
    - 3) Push-button and key operated control stations with open, close, and stop buttons.
    - 4) Flush mounting.
    - 5) Surface mounting.
    - 6) Interior location.
    - 7) Exterior location.
    - 8) Both interior and exterior location.
    - 9) One Open/Close/Stop push button station incorporated into Control Panel.
    - 10) Radio control
    - 11) Loop detectors
    - 12) Motion detectors

- c. Special Operation:
  - 1) Pull switch.
  - 2) Vehicle detector operation.
  - 3) Radio control operation.
  - 4) Card reader control.
  - 5) Photocell operation.
  - 6) Door timer operation.
  - 7) Commercial light package.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until openings have been properly prepared.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.
- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 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.

### **3.3 INSTALLATION**

- A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- C. Anchor assembly to wall construction and building framing without distortion or stress.
- D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- E. Fit and align door assembly including hardware.
- F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

### **3.4 CLEANING AND ADJUSTING**

- A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
- B. Clean doors, frames and glass.
- C. Remove temporary labels and visible markings.

### 3.5 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.
- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

**END OF SECTION**



SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Plumbing demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing 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 plumbing 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.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

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- 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 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.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 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.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

### 2.3 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 (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

### 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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.

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- 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.

2.6 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

2.7 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 (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

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3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 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.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

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- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) 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 (25-mm) 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.

### 3.3 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 "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

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- 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  4. 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.
  5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- 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.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

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2. Install flanges, in piping NPS 2-1/2 (DN 65) 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.

3.5 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.

3.6 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 (100 mm) 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 (450-mm) 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 (20.7-MPa) 28-day compressive-strength concrete and reinforcement as specified in Division 03 Sections.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.



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- 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.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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.

3.9 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 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

## 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Smith, Jay R. Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL 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. Presealed Systems.

- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, 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

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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.
3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. 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 for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6. Galvanized-steel wall sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve seal.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve seal.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6 : Galvanized-steel wall sleeves with sleeve seal.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve seal.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6 : Galvanized-steel-pipe sleeves.

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- b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.



- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for 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.
    - 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, cast-brass type with polished, chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
    - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
    - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
  - 2. Escutcheons for Existing Piping:
    - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

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- g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
  - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
  - i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
  - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Bronze globe valves.
17. Iron globe valves.
18. Lubricated plug valves.
19. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.

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- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. 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.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Grooved: With grooves according to AWWA C606.
  - 3. Solder Joint: With sockets according to ASME B16.18.
  - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

- A. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jomar International, LTD.
    - b. Kitz Corporation.
    - c. Marwin Valve; a division of Richards Industries.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - e. Conbraco Industries, Inc.; Apollo Div.
    - f. Grinnell Corporation.

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- g. Jamesbury, Inc.
- h. NIBCO INC.
- i. PBM, Inc.

2. Controls Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Dover Corp.; Dover Resources Company; Norriseal Div.
- i. Flo Fab Inc.
- j. Grinnell Corporation
- k. Hammond Valve.
- l. Kitz Corporation.
- m. Legend Valve.
- n. Milwaukee Valve Company.
- o. Mueller Steam Specialty; a division of SPX Corporation.
- p. NIBCO INC.
- q. Norriseal; a Dover Corporation company.
- r. Red-White Valve Corporation.
- s. Spence Strainers International; a division of CIRCOR International.
- t. Sure Flow Equipment Inc.
- u. Tyco International, Ltd.; Tyco Valves & Controls.
- v. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

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- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. Bray Controls; a division of Bray International.
  - c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
  - d. Crane Co.; Crane Valve Group; Flowseal.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. DeZurik Water Controls.
  - g. Hammond Valve.
  - h. Jamesbury; a subsidiary of Metso Automation.
  - i. Milwaukee Valve Company.
  - j. NIBCO INC.
  - k. Process Development & Control, Inc.
  - l. Tyco Valves & Controls; a unit of Tyco Flow Control.
  - m. Xomox Corporation.
- 2. Description:
  - a. Standard: MSS SP-68.
  - b. CWP Rating: 285 psig at 100 deg F.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
  - e. Seat: Reinforced PTFE or metal.
  - f. Stem: Stainless steel; offset from seat plane.
  - g. Disc: Carbon steel.
  - h. Service: Bidirectional.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers:

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- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61 or ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

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

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Grinnell Corporation.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Watts Industries, Inc.; Water Products Div.
- k. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

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

- a. Crane Co.; Crane Valve Group; Crane Valves.



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- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Cincinnati Valve Company
- e. Flomatic Valves
- f. Grinnell Corporation
- g. Hammond Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
- c. NPS 14 to NPS 24, CWP Rating: 300 psig.
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.

2.8 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

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

- a. Hammond Valve.
- b. Kitz Corporation.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Powell Valves.
- f. Red-White Valve Corporation.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- h. American Valve, Inc.
- i. Grinnell Corporation.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron bronze, or aluminum.

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2.9 IRON GATE VALVES

A. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. NIBCO INC.
  - d. Cincinnati Valve Company
  - e. Grinnell Corporation
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Disc: Solid wedge.
  - h. Packing and Gasket: Asbestos free.

B. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Powell Valves.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - h. Grinnell Corporation
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Disc: Solid wedge.
  - h. Packing and Gasket: Asbestos free.

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2.10 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to butterfly valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. 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.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

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- E. Install chainwheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Lift Check Valves: With stem upright and plumb.
- G. Provide an additional six (6) valves of each type and size used in the project to accommodate interferences and/or as directed by Engineer.

### 3.3 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.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly or gate valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: ball, or butterfly valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 : Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

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3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: may be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 250, metal seats.
5. Iron Gate Valves: Class 250, NRS or OS&Y.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass and Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, [NRS, bronze.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150, single flange.
5. Iron Swing Check Valves: Class 250, metal seats.
6. Iron Gate Valves: Class 250, NRS or OS&Y.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND 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:

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 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
2. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 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.

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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.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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.

1.6 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

2.1 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 stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:

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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 stainless steel

2.2 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.

2.3 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 stainless steel

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

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products 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.



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4. Channels: Continuous slotted steel channel with inturred 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 stainless steel
7. Metallic Coating: Electroplated zinc

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 552, Type II cellular glass with 100-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.

2.6 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, stainless-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.

2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

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- 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 stainless-steel 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. Base: Stainless steel.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.8 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.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.10 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

3.1 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. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.
- H. 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.

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- I. 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.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. 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.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. 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.
- Q. 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:

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- a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
  - b. NPS 4 : 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6 : 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 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.

### 3.2 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.

### 3.3 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.

### 3.4 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 .

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for

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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.

### 3.6 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 metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel 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.

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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.

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- 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:



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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

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

1.3 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.

1.4 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

### 2.1 EQUIPMENT LABELS

#### A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel self-tapping screws.
5. 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.

### 2.2 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: White

#### C. Background Color: Red

#### 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 self-tapping screws.

#### H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 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.

## 2.4 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: Stainless steel, 0.025-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.

## 2.5 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

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 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(Label piping as CWS, HWS, HWR):
  - a. Background Color: White
  - b. Letter Color: Blue
- 2. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Black
  - b. Letter Color: White
- 3. Compressed Air Piping:

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- a. Background Color: White
- b. Letter Color: Green

3.4 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 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. Cold Water: 2 inches , round
    - b. Hot Water: 2 inches , round
  - 2. Valve-Tag Color:
    - a. Cold Water: Green
    - b. Hot Water: Green
  - 3. Letter Color:
    - a. Cold Water: White
    - b. Hot Water: White

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Insulation Materials:
  - a. Calcium silicate.
  - b. Cellular glass.
  - c. Flexible elastomeric.
  - d. Mineral fiber.
  - e. Phenolic.
  - f. Polyisocyanurate.
  - g. Polyolefin.
  - h. Polystyrene.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

- B. Related Sections include the following:
1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

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1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
  - 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. Sample sizes are as follows:
    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.
- 1.4 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.



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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.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
1. Piping Mockups:
    - a. One 10-foot section of NPS 2 straight pipe.
    - b. One each of a 90-degree threaded, welded, and flanged elbow.
    - c. One each of a threaded, welded, and flanged tee fitting.
    - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
    - e. Four support hangers including hanger shield and insert.
    - f. One threaded strainer and one flanged strainer with removable portion of insulation.
    - g. One threaded reducer and one welded reducer.
    - h. One pressure temperature tap.
    - i. One mechanical coupling.
  2. Equipment Mockups: One tank or vessel.
  3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  5. Obtain Architect's approval of mockups before starting insulation application.
  6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  8. Demolish and remove mockups when directed.

1.5 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.

1.6 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

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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.

## 1.7 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

### 2.1 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.

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6. Preformed Pipe Insulation with Factory-Applied ASJ: 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 Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
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.
- J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000(Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.

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2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 3 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  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.
  
- B. 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.

2.3 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.
  1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Childers Products, Division of ITW; CP-96.
  - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric and Polyolefin 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.; Aero seal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. 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.
  2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. 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.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. 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.

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- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Speedline Corporation; Speedline Vinyl Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 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 in compliance with 40 CFR 59, Subpart D (EPA Method 24).
- B. 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.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-30.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
    - c. ITW TACC, Division of Illinois Tool Works; CB-25.
    - d. Marathon Industries, Inc.; 501.
    - e. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

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5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

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

- a. Childers Products, Division of ITW; Encacel.
- b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
- c. Marathon Industries, Inc.; 570.
- d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.

3. Service Temperature Range: Minus 50 to plus 220 deg F.

4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

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

- a. Childers Products, Division of ITW; CP-10.
- b. Foster Products Corporation, H. B. Fuller Company; 35-00.
- c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
- d. Marathon Industries, Inc.; 550.
- e. Mon-Eco Industries, Inc.; 55-50.
- f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 200 deg F

4. Solids Content: 63 percent by volume and 73 percent by weight.

5. Color: White.

## 2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, 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.

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B. 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.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. 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.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 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. 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:



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- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 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.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
  - 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.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; 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 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.
  4. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:

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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. Factory cut and rolled to size.
  - 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.

D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Pittsburgh Corning Corporation; Pittwrap.
  - b. Polyguard; Insulrap No Torch 125.

## 2.8 TAPES

A. ASJ Tape: White 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 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.

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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.
- B. 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.
- C. 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.
- D. 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 .

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4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches
3. Film Thickness: 6 mils
4. Adhesive Thickness: 1.5 mils
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.9 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 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.
2. 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.
3. 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.

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- 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.
  - 4. 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.
  - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
  - D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized 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.
- 2.10 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.

### PART 3 - EXECUTION

#### 3.1 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.

#### 3.2 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.

#### 3.3 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.

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- 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. Provide an additional twenty five feet of preformed insulation and twenty five square feet of blanket and board type insulation as well as accessories and labor for each size, thickness and type used on the project to accommodate any changes required to resolve interferences or as directed by the Engineer.
- 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 4 inches o.c.

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- 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 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.

### 3.4 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



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- 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.
1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. 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.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

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6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.6 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.

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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 (50 mm) 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.

### 3.7 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:

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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.

3.8 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.

3.9 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe 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.

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3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, 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 mineral-fiber blanket 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.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

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.

B. 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.

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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.
- C. 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.
- D. 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.
- E. 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.

### 3.11 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.

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- 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.

3.12 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. Inspect field-insulated equipment, randomly selected by the Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten 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 ten locations of straight pipe, ten locations of threaded fittings, ten locations of welded fittings, five locations of threaded strainers, five locations of welded strainers, five locations of threaded valves, and five locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Domestic water pump insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- D. Domestic chilled-water (potable) pump insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- E. Domestic hot-water pump insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.



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- F. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.
- G. Domestic hot-water storage tank insulation shall be the following, of thickness to provide an R-value of 12.5:
  - 1. Mineral-fiber pipe and tank.
- H. Domestic water storage tank insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.
- I. Domestic chilled-water (potable) storage tank insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.
- J. Piping system filter-housing insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
  - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- C. Domestic Chilled Water (Potable):

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1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- D. Stormwater and Overflow:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- E. Roof Drain and Overflow Drain Bodies:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- G. Sanitary Waste Piping Where Heat Tracing Is Installed:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- H. Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1- inch thick.
- I. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- J. Hot Service Drains:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1-1/2 inches thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
  1. All Pipe Sizes: Insulation shall be the following:

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- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
  - C. Sanitary Waste Piping Where Heat Tracing Is Installed:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
  - D. Hot Service Drains:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- 3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE
- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
  - B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.
  - C. Chilled Domestic Water, All Sizes: Cellular glass, 2 inches thick.
- 3.18 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. Equipment, Concealed:
    - 1. Paper & Foil with Vapor Retarder
  - D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :
    - 1. PVC 30 mils thick.
  - E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :
    - 1. Painted Aluminum Smooth 0.032 inch thick.
  - F. Piping, Concealed:
    - 1. Paper & Foil with Vapor Retarder
  - G. Piping, Exposed:
    - 1. PVC 30 mils thick

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3.19 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. Equipment, Concealed:
  - 1. Aluminum, Smooth 0.040 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :
  - 1. Aluminum, Smooth 0.040 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches
  - 1. Aluminum, Smooth 0.040 inch thick.
- F. Piping, Concealed:
  - 1. Aluminum, Smooth 0.040 inch thick.
- G. Piping, Exposed:
  - 1. Aluminum, Smooth 0.040 inch thick.

3.20 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. 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 furnished by utility company for installation by Contractor.
6. Water meters.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.
- B. Performance Requirements: Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Domestic Water Service Piping: 160 psig.
  2. Domestic Water Distribution Piping: 125 psig.

1.4 SUBMITTALS

- A. Product Data: For the following products:
1. Specialty valves.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Flexible connectors.
  5. Water meters.

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6. Backflow preventers and vacuum breakers.
7. Water penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC equipment.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  1. Do not proceed with interruption of water service without Architect's, Construction Manager's, Engineers and Owner's written permission.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 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.

DUMONT MUNICIPAL AND POLICE BUILDING

## 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L 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.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
  - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

## 2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

## 2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Tube.
- C. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black.

## 2.5 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.

## 2.6 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.

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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, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Spears Manufacturing Company.
  2. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket[ or threaded] end.
- E. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
    - 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 or threaded plastic end, rubber O-ring, and union nut.



2.7 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, provide products by one of 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, provide products by one of 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 minimum.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.

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- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

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

F. Dielectric Nipples:

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

2.8 FLEXIBLE CONNECTORS

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

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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.

2.9 WATER METERS

A. Displacement-Type Water Meters:

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

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- 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, provide products by one of the following:
  - a. AALIANT; 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, provide products by one of 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.

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- 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. Fire-Service-Type Water Meters:

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

- a. Badger Meter, Inc.
- b. Mueller Company; Water Products Division.
- c. Schlumberger Limited; Water Division.
- d. Sensus Metering Systems.

- 2. Description:

- a. Standard: AWWA C703 and UL listing.
- b. Pressure Rating: 175-psig working pressure.
- c. Body Design:

- 1) Proportional, Detector-Type Water Meters: With meter on bypass.

- a) Bypass Meter: AWWA C701, turbine or AWWA C702, compound type with bronze case; size not less than one-half nominal size of main-line meter.

- 2) Turbine-Type Water Meters: With strainer, and with meter on bypass.

- a) Strainer: Full size, matching water meter.
    - b) Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2.

- d. Registration: In gallons or cubic feet as required by utility company.
  - e. Case: Bronze.
  - f. Pipe Connections for Meters NPS 2 and Smaller: Threaded.
  - g. Pipe Connections for Meters NPS 2-1/2 and Larger: Flanged.

E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

F. 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.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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 underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- 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 with 0.25 percent slope downward toward drain and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. 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.
- P. Install piping free of sags and bends.
- Q. Provide an additional twenty five feet of piping and accessories and labor for each size of pipe used on the project to accommodate any changes required to resolve interferences or as directed by the Engineer.
- R. Install fittings for changes in direction and branch connections.
- S. Install PEX piping with loop at each change of direction of more than 90 degrees.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- U. 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.
- V. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

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- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 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. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 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.



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- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 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.

3.6 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.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.

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- B. Water meters will be furnished and installed by utility company.
- C. Install water meters according to AWWA M6, utility company's requirements, and the following:
- D. 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.
- E. Install turbine-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.
- F. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
- G. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
- H. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. 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.
- C. Support vertical piping and tubing at base and at each floor.

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- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. 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.
- F. Install supports for vertical copper tubing every 10 feet.
- G. 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.
- H. Install supports for vertical steel piping every 15 feet.
- I. 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.
- J. 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.
- K. 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.

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- L. Install hangers for vertical PEX piping every 48 inches.
- M. 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.
- N. Install supports for vertical PVC piping every 48 inches.
- O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.10 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. 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.
  - 4. 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.

3.11 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.

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3.12 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.

### 3.13 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.

### 3.14 CLEANING

- A. Clean and disinfect potable and 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 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.

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- 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.

3.15 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.
1. Underground Domestic Water piping materials shall match those used for the underground site main to the building Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings and brazed joints.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:

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1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.
- G. Underground Domestic Water piping materials shall match those used for the underground site main to the building:

3.16 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: [Calibrated] [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.

END OF SECTION 221116



## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Ground hydrants.
12. Post hydrants.
13. Drain valves.
14. Water hammer arresters.
15. Air vents.
16. Trap-seal primer valves.
17. Trap-seal primer systems.

- B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

### PART 2 - PRODUCTS

#### 2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 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. Ames Co.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. FEBCO; SPX Valves & Controls.
    - e. Rain Bird Corporation.
    - f. Toro Company (The); Irrigation Div.
    - g. Watts Industries, Inc.; Water Products Div.
    - h. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:

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. Arrowhead Brass Products, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. Legend Valve.
  - e. MIFAB, Inc.
  - f. Prier Products, Inc.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Woodford Manufacturing Company.
  - i. Zurn Plumbing Products Group; Light Commercial Operation.
  - j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome, nickel plated or rough bronze.

C. Pressure Vacuum Breakers:

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 by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Toro Company (The); Irrigation Div.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Plumbing Products Group; Wilkins Div.

4. Standard: ASSE 1020.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
7. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

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. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
  - c. Woodford Manufacturing Company.
  - d. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1035.
4. Size: NPS 1/4 or NPS 3/8 matching faucet size.
5. Body: Bronze.
6. End Connections: Threaded.
7. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

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. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1056.
4. Operation: Continuous-pressure applications.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## 2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

**B. Double-Check Backflow-Prevention Assemblies:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; [cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1047 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved].
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
  - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
  - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

E. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. FEBCO; SPX Valves & Controls.
  - c. Flomatic Corporation.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CLA-VAL Automatic Control Valves.
  - b. Flomatic Corporation.
  - c. OCV Control Valves.
  - d. Watts Industries, Inc.; Ames Fluid Control Systems.
  - e. Watts Industries, Inc.; Watts ACV.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
  - a. Pattern: Angle or Globe-valve design
  - b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Taco, Inc.
  - g. Watts Industries, Inc.; Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze,



4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Watts Industries, Inc.; Water Products Div.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Hammond Valve.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## 2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

### A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. Honeywell Water Controls.
  - e. Legend Valve.
  - f. Leonard Valve Company.
  - g. Powers; a Watts Industries Co.
  - h. Symmons Industries, Inc.
  - i. Taco, Inc.
  - j. Watts Industries, Inc.; Water Products Div.
  - k. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated or Rough bronze.

### B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.
  - a. Armstrong International, Inc.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Exposed-mounting, thermostatically controlled water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded inlets and outlet.
8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

9. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
10. Pressure Drop at Design Flow Rate: 15 psig.
11. Valve Finish: Chrome plated or Rough bronze.
12. Piping Finish: Copper.

C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Leonard Valve Company.
  - b. Powers; a Watts Industries Co.
  - c. Symmons Industries, Inc.
2. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly in three-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
9. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
10. Unit Pressure Drop at Design Flow Rate: 15 psig.
11. Thermostatic Mixing Valve and Water Regulator Finish: Chrome plated or rough bronze.
12. Piping Finish: Copper.

D. Individual-Fixture, Water Tempering Valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Lawler Manufacturing Company, Inc.
  - e. Leonard Valve Company.
  - f. Powers; a Watts Industries Co.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

E. Primary Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Heat-Timer Corporation.
  - b. Holby Valve Co., Inc.
2. Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual.
6. Inlets and Outlet: Threaded.
7. Valve Finish: Rough bronze.

## 2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.033 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

## 2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. IPS Corporation.
  - d. LSP Products Group, Inc.
  - e. Oatey.
  - f. Plastic Oddities; a division of Diverse Corporate Technologies.
  - g. Symmons Industries, Inc.
  - h. Watts Industries, Inc.; Water Products Div.
  - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
  - j. Zurn Plumbing Products Group; Light Commercial Operation.
2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. IPS Corporation.
  - c. LSP Products Group, Inc.
  - d. Oatey.
  - e. Plastic Oddities; a division of Diverse Corporate Technologies.
2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## 2.8 HOSE STATIONS

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

1. ARCHON Industries, Inc.
2. Armstrong International, Inc.
3. Cooney Brothers, Inc.
4. DynaFluid Ltd.
5. Leonard Valve Company.
6. Strahman Valves, Inc.
7. T & S Brass and Bronze Works, Inc.

B. Single-Temperature-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze with stainless-steel wetted parts.
5. Body Finish: Rough bronze or chrome plated.
6. Mounting: Wall, with reinforcement.
7. Supply Fitting: NPS 3/4 gate, globe, or ball valve and check valve and NPS 3/4 copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
9. Nozzle: With hand squeeze on-off control.
10. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

C. Hot- and Cold-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Type Faucet: Blending valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze with stainless-steel wetted parts.
6. Body Finish: Rough bronze or chrome plate.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: Two NPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.

10. Nozzle: With hand squeeze on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

## 2.9 HOSE BIBBS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Woodford Manufacturing Company.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.

3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

## 2.11 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### B. Gate-Valve-Type, Hose-End Drain Valve:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.



5. Drain: NPS 1/8 side outlet with cap.

## 2.12 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

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. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Metal Bellows, see fixture schedule.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.13 AIR VENTS

### A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 or NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

### B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

## 2.14 TRAP-SEAL PRIMER VALVES

### A. Supply-Type, Trap-Seal Primer Valves:

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. MIFAB, Inc.
  - b. PPP Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

### B. Drainage-Type, Trap-Seal Primer Valves:

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. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: NPS 1-1/4 minimum.
5. Material: Chrome-plated, cast brass.

## 2.15 TRAP-SEAL PRIMER SYSTEMS

### A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. PPP Inc.
2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Six.
8. Size Outlets: NPS 1/2.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.

- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump].
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
  - 1. Install shutoff valve on outlet if specified.
  - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- J. Install ground hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- K. Install draining-type post hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set post hydrants in concrete paving or in [1 cu. ft.] <Insert dimension> of concrete block at grade.
- L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.
- N. Install water hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- P. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Double-check backflow-prevention assemblies.
  - 4. Dual-check-valve backflow preventers.
  - 5. Double-check, detector-assembly backflow preventers.
  - 6. Water pressure-reducing valves.
  - 7. Calibrated balancing valves.
  - 8. Primary, thermostatic, water mixing valves.
  - 9. Manifold, thermostatic, water-mixing-valve assemblies.
  - 10. Primary water tempering valves.
  - 11. Outlet boxes.
  - 12. Hose stations.
  - 13. Supply-type, trap-seal primer valves.
  - 14. Trap-seal primer systems.
- B. 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."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### 3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 224000 - PLUMBING FIXTURES

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 plumbing fixtures and related components.
- B. Related Sections include the following:
  - 1. Provide plumbing fixtures in accordance with the fixtures schedules provided on the drawings.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of 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.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture scheduled.
- B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components in the same category through one source from a single manufacturer.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and

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Public Law 101-336, "Americans with Disabilities Act";] about plumbing fixtures for people with disabilities.

- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for faucets:
  - 1. Faucets: ASME A112.18.1M.
  - 2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 3. Supply and Drain Fittings: ASME A112.18.1M.
  - 4. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  - 5. Faucets: ASME A112.18.1M.
  - 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  - 7. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- G. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Floor Drains: ASME A112.21.1M.
  - 2. Grab Bars: ASTM F 446.
  - 3. Hose-Coupling Threads: ASME B1.20.7.
  - 4. Hot-Water Dispensers: ASSE 1023 and UL 499.
  - 5. Off-Floor Fixture Supports: ASME A112.6.1M.
  - 6. Pipe Threads: ASME B1.20.1.
  - 7. Plastic Toilet Seats: ANSI Z124.5.
  - 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

1.7 EXTRA MATERIALS



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- 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. Supply, Flow-Control Fittings: Equal to 5 percent of amount of each type and size installed.
  - 2. Flushometer Valve, Repair Kits: Equal to 5 percent of amount of each type installed, but not less than 10 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in other Part 2 articles.
- B. Provide plumbing fixtures in accordance with the plumbing fixture schedule included with the contract drawings. Provide all accessories (carriers, mounting hardware, seats, etc) as required to install and operate plumbing fixtures even if not specifically shown on the drawings or required by the specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install counter-mounting fixtures in and attached to casework.
- C. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

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- D. 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 valve if stops are not specified with fixture.
- E. Install trap and tubular waste piping on drain outlet of each fixture and connect to drainage system.
- F. 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.
- G. Install toilet seats on water closets.
- H. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- I. 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.
- J. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Plumbing Specification Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.

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- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed 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.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Replace washers and seals of leaking and dripping faucets and stops.

3.6 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.
  - 3. Clean fixtures to a reasonable degree of shine. No visible grease or other marks from construction should be apparent.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 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, 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 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.

1.3 SUBMITTALS

- A. Welding certificates.

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1.4 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.
- D. Sheet metal construction documents are diagrammatic. Equivalent sizes can be substituted when construction begins as long as aspect ratios are no greater than 3:1 for rectangular, or round instead of square substitutions provide the same static pressure per 100ft. Duct runs are to be coordinated in the field with the other trades. Duct materials can not be changed without the permission of the engineer. Flex ducts are to be no longer than eight feet and must be supported from overhead.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. 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.

### 2.3 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 (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

### 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.

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- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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.

2.6 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.

## 2.7 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 (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.



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- 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.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) 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.

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- 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 (25-mm) 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.

### 3.3 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.

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- 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.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) 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.

### 3.5 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.

### 3.6 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 (100 mm) 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 (450-mm) 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 (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Sections.

### 3.7 PAINTING AND FINISHING

- A. Apply semi-gloss, acrylic-enamel finish to exposed piping according to the following:
  - 1. Interior, Ferrous Piping and Ferrous Supports: Finish coat over enamel undercoat and primer.
  - 2. Interior and Exterior, Galvanized-Steel Piping: Two finish coats over galvanized metal primer.

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3. Exterior, Ferrous Piping and Ferrous Supports: Two finish coats over rust-inhibitive metal primer.
4. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved. Repair cut surfaces to match adjacent surfaces.

3.9 CONTROLS COORDINATION

- A. For electrical interface of controls the following is the method to be coordinated with division 23. Division 23 is to provide junction box with cover, conduit, and power to JB. The cover is to be labeled with its respective panel number and breaker number. Control contractor will provide the control transformers and all wiring there after to devices and is to coordinate with Division 16 in the field.

3.10 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.

3.11 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.

3.12 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

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- 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 3300 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: Energy efficient, as defined in NEMA MG 1.
- 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.



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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 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND 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:

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. Equipment supports.

B. Related Sections:

1. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
2. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 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 HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

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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.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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.

1.6 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

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

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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 stainless 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 stainless steel.

## 2.2 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.

## 2.3 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 stainless steel.

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.

## 2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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

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- 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 stainless steel.
  7. Metallic Coating: Electroplated zinc.
  8. Paint Coating: Epoxy.
  9. Plastic Coating: Epoxy.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Allied Tube & Conduit.
  2. Champion Fiberglass, Inc.
  3. Cooper B-Line, Inc.
  4. SEASAFE, INC.; a Gibraltar Industries Company.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
  1. Channels: Continuous slotted fiberglass channel with inturned lips.
  2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.

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5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-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 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.

2.7 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, stainless-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.

2.8 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 stainless-steel 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. Base: Stainless steel.

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3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.10 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

### 3.1 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.

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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. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. 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.
- H. 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.
- 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.



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- 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.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 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.

### 3.2 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.

### 3.3 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.

### 3.4 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.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide 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 painting Sections.

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 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 metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper 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.

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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.

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- 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.

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- 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.

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END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND 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:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

1.3 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.

1.4 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

### 2.1 EQUIPMENT LABELS

#### A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel self-tapping screws.
5. 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.

### 2.2 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: White

#### C. Background Color: Red

#### 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.

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- G. Fasteners: Stainless-steel 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.

### 2.3 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.

### 2.4 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: White .
- C. Background Color: Black
- 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 self-tapping screws.

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- 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.

## 2.5 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: Stainless steel, 0.025-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.

## 2.6 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

### 3.1 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.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 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. Refrigerant Piping:
    - a. Background Color: Black.
    - b. Letter Color: Yellow.

### 3.4 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.

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- B. 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.

3.5 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. Chilled Water: 2 inches, round.
    - b. Condenser Water: 2 inches, round.
    - c. Refrigerant: 2 inches, round.
    - d. Hot Water: 2 inches, round.
    - e. Gas: 2 inches, round.
  - 2. Valve-Tag Color:
    - a. Chilled Water: Blue.
    - b. Condenser Water: Yellow.
    - c. Refrigerant: Black.
    - d. Hot Water: Red.
    - e. Gas: Yellow.
  - 3. Letter Color:
    - a. Chilled Water: White.
    - b. Condenser Water: Black.
    - c. Refrigerant: White.
    - d. Hot Water: White.
    - e. Gas: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

## SECTION 23 34 00 - HVAC Fans

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. The ceiling-mounted circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.
- B. Summary of Work
  - 1. Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others. Factory installation services are available through Big Ass Fans. Consult the appropriate installation scope of work for information on the available factory installation options, overview of customer and installer responsibilities, and details on installation site requirements.

#### 1.2 RELATED SECTIONS

- A. 21 00 00 Fire Suppression
- B. 23 00 00 Heating, Ventilating, and Air Conditioning (HVAC)
- C. 26 00 00 Electrical

#### 1.3 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. Underwriters Laboratories (UL)
- C. Canadian Standards Association (CSA)
- D. National Electrical Code (NEC)
- E. International Organization for Standardization (ISO)
- F. Air Movement and Control Association Inc. (AMCA)
  - 1. AMCA Publication 211-13 - Certified Ratings Program - Product Rating Manual for Fan Air Performance
  - 2. AMCA 230-15 - Standard Laboratory Methods of Testing Air Circulating Fans for Rating and Certification
- G. American National Standards Institute (ANSI)
- H. Nationally Recognized Testing Laboratory (NRTL)
- I. European Community (CE)
- J. UK Conformity Assessed (UKCA)

#### 1.4 SUBMITTALS

- A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods
- B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information
- C. Revit Files: Files provided for architectural design
- D. IES Files (fans with optional light kit)
- E. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All information is subject to change without notice.
- F. Schedule
- G. Provide manufacturer's certification that high volume, low speed fans are licensed to bear the Air Movement and Control Association (AMCA) Certified Rating Seal for Circulating Fan Performance.

#### 1.5 QUALITY ASSURANCE

- A. Certifications
  - 1. The fan assembly, as a system (without light kit), shall be Nationally Recognized Testing Laboratory (NRTL)-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standards 22.2 No. 60335-1 and 22.2 No. 113.
  - 2. The fan assembly, as a system (without light kit), shall be CE- and UKCA-compliant.
  - 3. The fan (without light kit) shall be compliant with NFPA 13—Standard for the Installation of Sprinkler Systems, NFPA 72—National Fire Alarm and Signaling Code, and NFPA 70—NEC.
  - 4. Controllers shall comply with NEC and UL standards and shall be labeled where required by code.

5. The optional LED light kit shall be compliant with UL standard 1598 and CSA standard 22.2 No. 250.
  6. Performance ratings (airflow and power) shall conform to AMCA standard 211. Fans must be tested in accordance with ANSI/AMCA Standard 230-15 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA Seal for Circulating Fan Performance.
- B. Manufacturer Qualifications
1. The fan and any accessories shall be supplied by Big Ass Fans that has a minimum of twenty (20) years of product experience.
  2. ISO 9001 compliant

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- B. The fan and its components shall be stored in a safe, dry location until installation.

## 1.7 WARRANTY

- A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Warranty in accordance to the following schedule:

Mechanical <sup>†</sup>	10 years
Electrical <sup>††</sup>	5 years (no factory install <sup>†††</sup> ); 10 years (factory install <sup>††††</sup> )
Labor	1 year

<sup>†</sup> "Mechanical" is defined as mechanical components of the fan, including, the gearbox, fan hub, motor frame, mounting, airfoils, and winglets.

<sup>††</sup> "Electrical" is defined as electrical and electronic components of the fan, including the motor, motor drive, variable frequency drive, and any standard controller or accessories.

<sup>†††</sup> The No Factory Install Warranty Period defined above for "Electrical" applies to proper installations by any other state-qualified or licensed electrical contractor.

<sup>††††</sup> The Factory Install Warranty Period defined above for "Electrical" requires installation to be purchased from Big Ass Fans and performed by a factory-approved, Big Ass Fans Certified Installer.

<sup>†††††</sup> All reasonable costs of repair or replacement will be paid or reimbursed provided customer obtains pre-approval.

<sup>††††††</sup> The Warranty Period for light kits is limited to 1 year (parts).

<sup>†††††††</sup> The Warranty period for any manufacturer defects or flaws to surface finishes is limited to 1 year.

<sup>††††††††</sup> All products are considered for indoor use only unless specifically specified on the product label.

<sup>†††††††††</sup> See the complete warranty for more details.

## PART 2 PRODUCT

### 2.1 MANUFACTURER

- A. Delta T LLC, dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575.  
Phone (877) 244-3267. Fax (859) 233-0139. Website: www.bigassfans.com.

### 2.2 HIGH VOLUME, LOW SPEED FANS – BIG ASS FANS ESSENCE

- A. Complete Unit
  1. Regulatory Requirements: The entire fan assembly (without light kit) shall be NRTL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standards 22.2 No. 60335-1 and 22.2 No. 113.
  2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification of conditioned commercial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 40 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
  3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.
  4. High volume, low speed (HVLS) fans shall be licensed to bear the AMCA Certified Rating Seal for Circulating Fan Performance to ensure performance as cataloged in the field. Unlicensed HVLS fans shall not be accepted.
- B. Controls
  1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to

minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.

C. Airfoil System

1. The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high-performance Mini-Elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless steel bolts and lock washers per airfoil.
2. The fan shall be equipped with eight (8) upswept winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black.
3. As an option, the fan shall be equipped with eight (8) plug-style airfoil tips, molded of high strength polymer, in place of the eight (8) upswept winglets. The airfoil tips shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the airfoil tips shall be black.

D. Motor

1. The motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control.
2. The motor shall operate from any voltage ranging from 100–120 VAC or 200–240 VAC, single phase, and 50/60Hz, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -4°F to 131°F (-20°C to 55°C) ambient condition.
3. The motor shall be rated IP43.
4. The standard color of the motor unit shall be white with silver trim or silver with black trim.

E. LED Light Kit (Optional)

1. The fan shall be equipped with a hollow shaft in which electrical wiring can be routed to below the fan.
2. The LED light kit shall operate independently from the fan at an operating voltage of 120–277 VAC, 50–60 Hz.
3. The standard color of the LED light kit components shall be white or silver.
4. As an option, Big Ass Fans can provide a controller to operate the LED light.
5. The LED light kit shall have a standard LED color temperature and lumen option of one of the following:
  - a. 3,000 CCT (4,800 lumens)
  - b. 4,000 CCT (5,000 lumens)

F. Essence with UV-C Technology (Optional)

1. The fan shall be equipped with a UV-C light, as specified by the architect or owner.
2. The UV-C light shall be installed on top of the fan motor hub and shall emit UV-C light while the fan is spinning.
3. For safety, the UV-C light shall only be able to be turned on while the fan is spinning.
4. The UV-C light kit shall include a UV-C LED light module that shall secure to the fan extension tube with two screws and two set screws. The kit shall also include a driver box that shall be installed near the ceiling for electrical connections.

G. Mounting System

1. The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" (0.5 cm) thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum, are acceptable.
2. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.

H. Hub

1. The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.

I. Safety Cable

1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be Ø3/16" (0.5 cm) diameter and fabricated out of 7 x 19 stranded galvanized steel, pre-loaded and tested to 3,200 lbf (13,345 N).
2. Field construction of safety cables is not permitted.

J. Wall Control



1. Wired (standard). The fan shall be equipped with a low-voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box. The wall control shall include a rotary-style dial for controlling the fan's power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be by a standard, commercially available CAT5 (or higher) Ethernet cable that is field installed and provided by the installer.
  2. Wireless (optional). As an option, the fan shall be equipped with a battery-operated radio frequency (RF) remote wall control in place of the wired wall control. The wall control shall include buttons for wirelessly controlling the fan's power and speed and for programming a preferred preset speed. The wall control shall be capable of functioning as a handheld remote control or can be mounted to a wall or other surface. Communication with the fan drive and controller shall be wireless.
- K. Fire Control Panel Integration
1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.
- L. Guy Wires
1. Guy wires shall be included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Fan location shall have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
- B. Mounting structure shall be able to support weight and operational torque of fan. Consult structural engineer if necessary.
- C. Fan location shall be free from obstacles such as lights, cables, or other building components.
- D. Check fan location for proper electrical requirements. Consult Installation Guide for appropriate circuit requirements.
- E. Each fan requires dedicated branch circuit protection.

### **3.2 INSTALLATION**

- A. The fan shall be installed by a factory-certified installer according to the manufacturer's Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle irons for bar joist applications. Big Ass Fans recommends consulting a structural engineer for installation methods outside the manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
- B. Minimum Distances
  1. Airfoils shall be at least 10 ft (3.05 m) above the floor.
  2. Installation area shall be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
  3. The structure the fan is attached to shall be capable of supporting a torque load of up to 40 ft·lb (54 N·m) of torque.
- C. The fan shall not be located where it shall be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the Big Ass Fans Installation Manual.
- D. The fan is suitable for use in wet locations when installed on a GFCI protected branch circuit.
- E. The optional LED light kit shall be installed on a separate circuit from the fan and shall be connected to the lighting grid control, not the fan control.
- F. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
  1. The maximum fan diameter shall be 24 ft (7.3 m).
  2. The HVLS fan shall be centered approximately between four adjacent sprinklers.
  3. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (0.9 m).
  4. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code.

END OF SECTION

## SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections:
  - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
  - 2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for balancing diffusers, registers and grilles.

#### 1.3 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

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- B. Manufacturers:
  1. Titus
  2. Tuttle & Bailey
  3. Price (Basis of Design)
  4. Krueger

### 2.2 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

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, 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.

### 3.2 INSTALLATION

- A. Install diffusers, registers, 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. Provide an additional five diffusers/registers of each type and size used on the project to accommodate ductwork revisions required to resolve interferences or as directed by the Engineer.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

### 3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 237334 –DUCTLESS SPLIT SYSTEMS

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

- A. The heat pump air conditioning system shall be a Trane ST split system series. The system shall consist of a slim silhouette, compact, wall mounted indoor fan coil section with wireless remote controller and a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven heat pump design.

1.2 QUALITY ASSURANCE

- A. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).
- E. A dry air holding charge shall be provided in the indoor section.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and carefully handled according to the manufacturer's recommendations.
- B. The wireless remote controller, for the wall mounted and floor standing indoor units, shall be shipped inside the carton and packaged with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.
- C. The remote controller, for the ceiling suspended, ceiling recessed and ducted indoor units, either wireless or wired, shall be shipped separately.

## PART 2- WARRANTY

### 2.1 WARRANTY

- A. Manufacturer shall provide a (1) year whole system PARTS AND LABOR warranty. Warranty shall be provided by the manufacturer. 3rd party warranties (contractor bond, AIG, self-performance, etc) are NOT acceptable and will be rejected.
- B. The units shall also have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation.
- C. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor past the first year.
- D. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor past the first year.
- E. Manufacturer shall have a minimum of thirty eight (38) years continuous experience in the U.S. market.
- F. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required.

## PART 3- OUTDOOR UNITS

### 3.1 ST WALL MOUNT SYSTEM

- A. General:
  - 1. The ST Series outdoor units are specifically designed to work with the ST indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
  - 2. If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

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3. Outdoor unit shall have a sound rating no higher than 55 dB(A). If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
4. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
5. The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
2. Cabinet color shall be Munsell 3Y 7.8/1.1.
3. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

C. Fan:

1. The unit shall be furnished with a direct drive propeller type fan.
2. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.
3. The fan motor shall be mounted for quiet operation.
4. The fan shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant and Refrigerant Piping:

1. R410A refrigerant shall be required for systems.
2. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.
4. All refrigerant piping must be insulated with ½” closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
5. Refrigerant line sizing shall be in accordance with manufacturer specifications.

E. Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant Blue Fin finish. Uncoated aluminum coils/fins are not allowed.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.
5. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to twenty five (25) feet of refrigerant piping for capacities up to 15,000 BTU/h, and up to thirty three (33) feet of refrigerant piping for capacities 18,000 BTU/h and above.
6. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1”



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thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

7. All refrigerant connections between outdoor and indoor units shall be flare type.

F. Compressor:

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.
2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
3. The compressor will be equipped with internal thermal overload protection.
4. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and refrigerant tubing length of 65 feet for capacities up to 15,000 BTU/h and a maximum height difference of 50 feet and refrigerant tubing length of 100 feet for capacities 18,000 BTU/h and above between indoor and outdoor units.
5. There shall be no need for line size changes. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.
6. The compressor shall be mounted so as to avoid the transmission of vibration.

G. Operating Range:

1. Operating Range shall be in accord with the Table below:

Operating Range		Indoor Intake Air Temp	Outdoor Intake Air Temp
Cooling	Maximum	95°F (35°C) DB, 71°F(21°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F(14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F(19°C) WB	75°F (24°C) DB, 65°F(18°C) WB
	Minimum	70°F (21°C) DB, 60°F(16°C) WB	6°F (-14°C) DB, 5°F(-15°C) WB -12°F (-24°C) DB, -13°F(-25°C) WB*

H. Electrical:

1. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
3. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.

PART 4- INDOOR UNITS

4.1 ST WALL MOUNTED INDOOR UNIT

A. General:

1. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.
3. There shall be a separate back plate which secures the unit firmly to the wall.

C. Fan:

1. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.
2. An integral, motorized, multi-position, horizontal air sweep vane shall provide for uniform air distribution, up and down. Vane shall have 5 selectable positions plus AUTO (Controls position based upon mode, microprocessor shall automatically determine the vane angle to provide the optimum room temperature distribution) and SWING (Continuously moves up and down). In OFF mode the horizontal vane shall return to the closed position.
3. A motorized adjustable vertical guide vane shall be provided with the ability to change the airflow from side to side (left to right). Vane shall be positioned by a stepper motor driven by the indoor unit control microprocessor. Vane shall have 5 selectable positions and SWING (Continuously moves left and right).
4. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of six (6) speed settings, Quiet, Low, Med, High, Super High and Auto (2 ton unit does not have Quiet setting).

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D. Filter:

1. Return air shall be filtered by means of two (2) easily removable, washable Nano Platinum Filters, and Electrostatic Anti-Allergy Enzyme Filters.

E. Coil:

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with silver alloy.
4. The coils shall be pressure tested at the factory.
5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.

F. Electrical:

1. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground.
3. The indoor unit shall not have any supplemental electrical heat elements.

G. Controls:

1. The unit shall include an IR receiver for wireless remote control flexibility
2. The unit shall ship with a wireless handheld remote with the unit
3. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

PART 5- CONTROLS

5.1 OVERVIEW

- A. The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via A-Control data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
- B. For A-Control, a three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.
- C. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.
- D. A remote controller needs to be selected and ordered separately from the unit unless the indoor unit is a wall mounted (excludes PKA), floor mounted or one-way ceiling recessed unit.

5.1 REMOTE CONTROLLERS

- A. Deluxe Wired MA Remote Controller:
  - 1. On wall mount (excludes PKA), floor mount and one-way ceiling recessed units the Deluxe Wired MA Remote Controller shall require a MAC-334IF-E Interface for communication.
  - 2. The Deluxe Wired MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). When grouping M-Series units each unit requires a MAC-334IF-E Interface.
  - 3. The Deluxe Wired MA Remote Controller shall only be used in same group with another Deluxe Wired MA Remote Controller, with up to two remote controllers per group.

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<b>Wired MA Remote Controller</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat. Operation modes vary depending on the air conditioner unit.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 87°F depending on operation mode and indoor unit.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Vane, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing a button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group
Schedule	Set up to 8 operations per day, 7 days per week. Operations include time on/off, mode and room temperature set point.	Each Group	Each Group

## 5.2 CMCN REMOTE CONTROLLERS: SYSTEM INTEGRATION

- B. The CMCN shall be capable of supporting integration with Building Management Systems (BMS).

SECTION 238233 – ELECTRIC BASEBOARD RADIATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Electric baseboard radiators.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For electric radiators to include in maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.3 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.

PART 2 - PRODUCTS

2.1 BASEBOARD RADIATORS

- A. Manufacturers:
  - 1. Chromalox, Inc.; a division of Emerson Electric Company.
  - 2. Markel Products; a division of TPI Corporation. (Basis of Design)
  - 3. Trane.
- B. Heating Elements: Nickel-chromium heating wire element enclosed in metallic sheath mechanically expanded into fins, with high-temperature cutout. Element supports eliminate thermal expansion noise.

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- C. Enclosures: One piece, steel, with full-height back, full-length damper, end panel, end caps, corners, and joiner pieces to snap together. Front panel shall be easily removable.
  - 1. Enclosure Height: 6 inches.
  - 2. Finish: Factory-applied baked enamel in color selected by Architect from manufacturer's standard colors.
  - 3. Element Brackets: Galvanized steel to support front panel and element glide.
- D. Unit Controls: Integral electronic thermostat.
- E. Capacity: as scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for electric radiators to verify actual locations of electrical connections before equipment installation.
- B. Examine walls for suitable conditions where electric radiators will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric baseboard level and plumb and according to the following, unless otherwise indicated:
  - 1. Install continuously around corners, using manufacturer's outside and inside corner fittings.
  - 2. Join sections with manufacturer's splicer, plates, and filler pieces to provide continuous cabinet.
  - 3. Install manufacturer's access fitting in cabinets for access to electrical connections, controls, and other fittings.
  - 4. Terminate enclosures with manufacturer's end caps.

3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

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3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing and prepare test reports:
1. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION



SECTION 238240 - ELECTRIC HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Propeller unit heaters with electric-resistance heating coils.
2. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Plans, elevations, sections, and details.
  2. Location and size of each field connection.
  3. Equipment schedules to include rated capacities, furnished specialties, and accessories.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 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.

PART 2 - PRODUCTS

2.1 CEILING HEATERS

A. Manufacturers:

1. Markel Products
2. Marley Electric Heating; a United Dominion Company.
3. Chromalox; Division of Emerson Electric Company.

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- B. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
  - 1. Markel Products; a division of TPI Corporation. (Basis of Design)
- C. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- D. Cabinet:
  - 1. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
  - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- E. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- F. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
- G. Fan: Aluminum propeller directly connected to motor.
  - 1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- H. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- I. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

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- C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
- F. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- G. Install piping adjacent to machine to allow service and maintenance.
- H. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- I. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- J. Comply with safety requirements in UL 1995.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. 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 motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238239

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL – MATERIALS AND METHODS GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Utility company electricity-metering components.
  - 6. Concrete equipment bases.
  - 7. Electrical demolition.
  - 8. Cutting and patching for electrical construction.

1.2 SUBMITTALS

- A. Product Data: For utility company electricity-metering components.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts and single-line diagram of electricity-metering component assemblies specific to this Project.

1.3 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. The contractor shall be fully responsible for all coordination of the electrical work required to meet the design intent and the scope of work related to the project. This includes but not limited to all other trades, material handling, equipment rentals, tools, automobiles, parking and travel expenses, engineering review and consult, as-built drawings and any/all construction site requirements that are necessary to provide a turnkey electrical installation.
- C. The 'Basis of Design' is the product that is specified which supports the design data contained within the contract documents. Should the contractor elect to use an alternate manufacturer listed within the specifications the contractor is still required to meet the full intent and specifications and the contract documents. Any deviation of the contract documents will be the sole responsibility of the contractor to maintain specification requirements at no additional cost to the owner.
- D. It shall be the contractor's responsibility to acknowledge any long lead delivery items with written response from the manufacturer, at the time of Notice to Proceed. Should the contractor fail to inform the client and the A/E of any material or equipment delays at the time Notice to Proceed has been given, the contractor will take full responsibility in completing the project in the same allowed construction period, based on the approved construction schedule.

- E. The contractor shall be fully responsible for the coordination and installation of all electrical products as per the manufacturer's recommendations. Should the contractor alter or change the manufacturer's installation recommendations, the contractor shall submit a certified installation report from the manufacturer's representative stating the installation is acceptable. Any discrepancies in the installation shall be corrected per the manufacturer's requirements at no additional cost to the owner and before final closeout of the project.
- F. Devices for Utility Company Electricity Metering: Comply and coordinate with local utility company requirements and Specification Section 262713 – Electricity Metering.
- G. Comply with NFPA 70.

#### 1.4 COORDINATION

- A. The contractor shall be fully responsible for the coordination of all electrical work required to meet the design intent and the scope of work related to the project. This includes but not limited to all other trades, material handling, equipment rentals, rigging equipment, cranes, high reach man lifts, tools, automobiles, parking and travel expenses, engineering review and consult, as-built drawings and any/all construction site requirements that are necessary to provide a turnkey electrical installation.
- B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate electrical service connections to components furnished by utility companies.
  - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- E. Devices for Utility Company Electricity Metering: Comply and coordinate with local utility company requirements and published standards.
- F. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- G. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- H. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

- I. The contractor shall field verify all existing conductor phasing for each individual circuit feeder whether it be primary or secondary feeds to and from the new electrical equipment. The contractor is fully responsible for tagging and phasing all branch circuits. Any disruption or equipment failure caused by phase crossing shall be the full responsibility of the contractor to replace and or repair any/all damages that may occur at no additional cost.

#### 1.5 ITEMS NOT SHOWN OR SPECIFIED

- A. Any item of material not indicated on the drawings and/or not specified, but which is required for the complete and proper installation and/or operation of any part of the work, shall be provided as if indicated and specified, at no additional cost to the Owner.
- B. Any work not indicated on the drawings and/or not specified, but which is required for compliance with applicable codes and regulations, shall be provided as if indicated and specified, at no additional cost to the Owner.

### PART 2 - PRODUCTS

#### 2.1 RACEWAYS

- A. EMT: Electrical metallic tubing; ANSI C80.3, zinc-coated steel, with compression fittings.
- B. FMC: Flexible metal conduit; zinc-coated steel.
- C. IMC: Intermediate metal conduit; ANSI C80.6, zinc-coated steel, with threaded fittings.
- D. LFMC: Liquidtight flexible metal conduit; zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
- E. RMC: Rigid metal conduit; galvanized rigid steel; ANSI C80.1.
- F. RNC: Rigid nonmetallic conduit; NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
- G. Raceway Fittings: Specifically designed for raceway type with which used.

#### 2.2 WIRES, CABLES, AND CONNECTIONS

- A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- B. Conductors, Larger Than No. 10 AWG: Stranded copper.
- C. Insulation: Thermoplastic, rated 600 V, 75 deg C minimum, Type THW, THHN-THWN, or USE depending on application.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

#### 2.3 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs. Strength rating to suit structural loading.
- D. Nonmetallic Slotted Channel and Angle: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (203 mm) o.c. in at least one surface. Strength rating to suit structural loading.
- E. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.
  - 1. Materials: Same as channels and angles, except metal items may be stainless steel.
- F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- H. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- I. Expansion Anchors: Carbon-steel wedge or sleeve type.
- J. Toggle Bolts: All-steel springhead type.
- K. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.4 ELECTRICAL IDENTIFICATION

- A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than .1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
- C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
  - 1. Not less than .6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).

2. Embedded continuous metallic strip or core.
  3. Printed legend that indicates type of underground line.
- F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.
- G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
  2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch (1-mm), galvanized-steel backing. 1/4-inch (6-mm) grommets in corners for mounting.
- H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

## 2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Comply with requirements of the local electrical power utility company for meter sockets and current transformer cabinet and as per Specification Section 262713 – Electricity Metering.
- B. Provide Cold Sequence Meter Protection Switch as required by the Local Utility Company.
- C. The contractor shall coordinate and provide any/all metering equipment for low and medium voltage equipment provisions not directly supplied by the local utility company.

## 2.6 CONCRETE BASES

- A. Provide 6" high concrete sub-bases for all floor mounted electrical equipment within spaces that are below exterior finished grade and/or in spaces that are installed where water or liquids may be dispersed from local equipment or building appurtenances.
- B. Where concrete bases are required, provide approved anchoring systems and methods to apply the base to the flooring and for the equipment being supported.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.



- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Electrical equipment shall be installed at elevations where the disconnecting means is not greater than 6'-6" above the accessible, working floor elevation (unless noted otherwise).
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

### 3.2 RACEWAY APPLICATION

#### A. Outdoor Installations:

1. Exposed: RMC.
2. Concealed: RNC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4, unless otherwise indicated.

#### B. Indoor Installations:

1. Exposed: EMT except in wet or damp locations, use IMC.
2. Concealed in Walls or Ceilings: FMC.
3. In Concrete Slab: RNC.
4. Below Slab on Grade or in Crawlspace: RNC
5. Connection to Vibrating Equipment: FMC; except in wet or damp locations: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

### 3.3 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Keep legs of raceway bends in the same plane and keep straight legs of offsets parallel.
- C. Use RMC elbows where RNC turns out of slab.
- D. Where required to provide a Rough-in Only device application concealed within the vertical walls the contractor shall provide the device work box and 3/4" EMT raceway to above the ceiling with a 90-degree bend turned into the ceiling space and apply an open end plastic bushing or cap for future wiring application.
- E. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or woven polypropylene or monofilament plastic line with not less than 200-lb. (90-kg) tensile strength. Leave at least 12 inches. (300 mm) of slack at each end of pull wires.
- F. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of .72-inches. (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

### 3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- A. Application: Use wiring methods specified below to the extent permitted by applicable codes as interpreted by authorities having jurisdiction.
- B. Exposed Feeders: Insulated single conductors in raceway.
- C. Concealed Feeders in Concrete: Insulated single conductors in PVC raceway.
- D. Exposed Branch Circuits Insulated single conductors in raceway.
- E. Concealed Branch Circuits: Insulated single conductors in FMC raceway.
- F. Underground Feeders and Branch Circuits: Insulated single conductors in raceway.
- G. Remote-Control Signaling and Power-Limited Circuits, Classes 1, 2, and 3: Insulated conductors in FMC raceway unless otherwise indicated.
- H. Provide PVC pipe sleeves for all non-fire rated interior masonry and below grade wall penetrations. Provide caulk/sealant for all wall penetrations installed.
- I. Provide Rigid metallic pipe sleeves for all fire rated masonry and exterior wall penetrations. Provide the rated fire caulk/sealant for all wall penetrations that match the rating of the fire wall.

### 3.5 WIRING INSTALLATION

- A. The contractor shall minimize all wire splices or taps. Should the need to provide splices or taps provide materials that are compatible with the connecting conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- B. Unless specified otherwise the contractor shall not exceed four (4) current carrying conductors plus ground in a single raceway.

### 3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, slotted channel system components.
- B. Dry Locations: Steel materials.
- C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb. (90-kg) minimum design load for each support element.

### 3.7 SUPPORT INSTALLATION

- A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

- B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.
- C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps.
- D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used in existing walls or floors. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:
  - 1. Wood: Wood screws or screw-type nails.
  - 2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
  - 3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.
  - 4. New Concrete: Concrete inserts with machine screws and bolts.
  - 5. Existing Concrete: Expansion bolts or threaded studs driven by powder charge and provided with lock washers.
  - 6. Structural Steel: Welded threaded studs.
    - a. Comply with AWS D1.1 for field welding.
  - 7. Light Steel Framing: Sheet metal screws.
  - 8. Fasteners for Damp, Wet, or Weather-Exposed Locations: Stainless steel.
  - 9. Light Steel: Sheet-metal screws.
  - 10. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.8 FIRESTOPPING

- A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies.

### 3.9 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions, and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety and back to electrical panel source.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

- D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

### 3.10 TEMPORARY ELECTRICAL POWER / SERVICES

- A. Provide all necessary temporary electrical construction power by either a temporary service power pole or by portable generator to maintain adequate electrical power requirements for the duration of construction, at no additional cost to the project or owner.
- B. Should the project include demolition or disruption of an existing electrical service the contractor shall provide temporary back-up power source and connection that meets the demand requirements of the disturbed service at no additional cost to the project or owner.

### 3.11 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair, refinish and touch up disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

END OF SECTION 260500

## SECTION 260519 - CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

#### 1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

#### 1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled" as defined in NFPA 70, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

- B. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. 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.

## 2.2 CONDUCTORS AND CABLES

- A. Manufacturers:
  - 1. American Insulated Wire Corp.; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Rome Cable Company.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material: Copper complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- D. Conductor Insulation Types: Type THW, THHN-THWN, XHHW and SO complying with NEMA WC 5 or 7.
- E. Conductor Insulation Type: Type XHHW where used exterior and below grade or in extreme wet location areas.
- F. Multi-conductor Cable: Armored cable Type FAC, Metal-clad cable Type FMC, and Type SO with ground wire. Armor shall be steel interlocked covering in NEMA 1 applications.

## 2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc.
  - 2. AMP Incorporated/Tyco International.
  - 3. Hubbell/Anderson.
  - 4. O-Z/Gedney; EGS Electrical Group LLC.
  - 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.4 HEAT TRACE CABLES AND COMPONENTS

- A. Provide a heat trace freeze protection system for above ground piping with a minimum rating of -20°F. Basis of Design: Raychem by Tyco Thermal Controls.  
  
Other Approved Manufacturers:
  - 1. Nelson Heat Trace – Emerson Industrial Automation
- B. The Raychem XL-Trace System shall be provided with all required control monitoring devices and 30-mA ground fault protection device.
- C. System shall be UL listed and FM approved for non-hazardous locations. Where hazardous locations apply comply with all current NFPA and EPA requirements.

- D. The self regulating, Raychem 12XL2 (12 watt/ft) heating cable shall be permanently secured to the metallic pipes with Raychem GT-66 glass reinforced tape. The cable shall be minimum 20-amp, 208 volt rated.
- E. For above ground system include the following devices:
  - 1. Power Connector – RayClip-PC
  - 2. Electronic thermostat – Raychem model EC-TS-AM8.
  - 3. Splices – RayClic-S
  - 4. Tees – RayClic-T
  - 5. End seal – RayClic – E
  - 6. Provide all miscellaneous installation components required by the manufacturer for a turnkey installation.

### PART 3 - EXECUTION

#### 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway, XHHW, single conductors in raceway.
- B. Exposed Feeders in raceway: Type THHN-THWN.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in EMT, FAC or FMC raceway.
- D. Feeders Concealed in Concrete or below Slabs-on-Grade: Type THHN-THWN, single conductors in PVC raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway that meets the crawlspace environment (no FAC or FMC).
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Electrical Metallic Tubing Type EMT, Armored cable Type FAC, or Metal-clad cable Type FMC.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in PVC raceway.
- H. Branch circuit homeruns exposed: Type THHN-THWN, single conductors in EMT or RMC.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord sized in accordance with the overcurrent protection device (breaker or fuse size) ‘not’ the amperage rating of the appliance.
- J. Exposed Fire Alarm Circuits: Type THHN-THWN, in raceway or Power-limited, fire-protective, signaling circuit cable in steel armor spiral cover, colored red or labeled EMT.
- K. Exposed Fire Alarm Circuits where existing architecturally finished wall surfaces exist to remain, the contractor shall provide Surface Mounted Raceway (such as Wiremold).
- L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

- M. Class 2 Control Circuits: Power-limited cable, concealed in building finishes (above acoustical ceilings and walls).

### 3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers & Supports".
- F. Provide an additional four hundred linear feet of cable/conductor and accessories of each type and size used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- H. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
  - 3. It is the electrical contractor's responsibility to confirm all wire and cable installations meet the necessary inspections and testing indicated in item 260519-3.4A paragraph #2 of this section. Should any failures be found during or immediately after construction the



contractor will be required to provide and third-party NETA testing agency to prepare a detailed inspection and approval report detailing all corrective measures at no additional cost. In addition, the contractor will be required to replace 100% of all damaged or failing installations at the contractor's expense. Should any work require replacement the contractor will be required to provide at no additional cost another NETA testing inspection to confirm corrective measures have been met.

- B. Test Reports: Prepare a written report to record the following should 260519-3.4A paragraph #3 be required:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Requirements specified in this Section may be supplemented by requirements of other Sections.

#### 1.2 SUBMITTALS

- A. Product Data: For ground rods and chemical rods.
- B. Field quality-control test reports.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

#### 1.4 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. Ground Rods-Provide an additional 4 ground rods of each type and size utilized on this project.
  - 2. Ground Conductors-Provide an additional 150 feet of each ground conductor type and size utilized on this project.
  - 3. Ground Connections-Provide an additional 4 connections of each type and size utilized on this project.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

1. Apache Grounding/Erico Inc.
2. Boggs, Inc.
3. Chance/Hubbell.
4. Copperweld Corp.
5. Dossert Corp.
6. Erico Inc.; Electrical Products Group.
7. Framatome Connectors/Burndy Electrical.
8. Ideal Industries, Inc.
9. ILSCO.
10. Kearney/Cooper Power Systems.
11. Korns, C. C. Co.; Division of Robroy Industries.
12. Lightning Master Corp.
13. Lyncole XIT Grounding.
14. O-Z/Gedney Co.; a business of the EGS Electrical Group.
15. Raco, Inc.; Division of Hubbell.
16. Robbins Lightning, Inc.
17. Salisbury, W. H. & Co.
18. Superior Grounding Systems, Inc.
19. Thomas & Betts, Electrical.

## 2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Equipment Grounding Conductors: Insulated with green-colored insulation.
- C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare, Solid-Copper Conductors: ASTM B 3.
- G. Assembly of Bare, Stranded-Copper Conductors: ASTM B 8.
- H. Bare, Tinned-Copper Conductors: ASTM B 33.
- I. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
- J. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- K. Tinned-Copper Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- L. Ground Conductor for Overhead Distribution: No. 4 AWG minimum, soft-drawn copper.

- M. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.
- N. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Compression type or exothermic-welded type, in kit form, selected per manufacturer's written instructions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
- B. Ground Rods: Sectional type; copper-clad steel.
  - 1. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
- C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
  - 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the indicated height above the floor.
- E. Underground Grounding Conductors: Use tinned-copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.
- F. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
  - 1. Install insulated equipment grounding conductors in feeders and branch circuits.

2. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  3. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
  4. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
  5. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install an insulated equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
  6. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
  7. Air-Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
  8. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
  9. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
    - a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a .1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
    - b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
  10. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.
  11. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- G. Metal Frame Grounding for Buildings: Drive a ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart. Connect rod to column with an underground grounding conductor. Interconnect ground rods with a continuous underground conductor, extending around the perimeter of the building, 24 inches (600 mm) minimum from building foundation. Use tinned-copper conductor not less than

No. 2/0 AWG for underground conductor and bury 18 inches (450 mm) below grade, minimum.

- H. Building Ground Rings: Provide a perimeter ground ring for the entire building as required per the National Electrical Code Article 250.66C.
- I. Bond all concrete encased electrode (foundation/footing reinforcing) Provide as required per National Electrical Code Article 250.66B.
- J. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
  - 1. Drive ground rods until the tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
  - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- K. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- L. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- M. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- N. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- O. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- P. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- Q. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- R. Connections: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.
  3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
  6. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
  7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
  8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
  9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
  10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
  11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate the entire area of connection and seal against moisture penetration of insulation and cable.
- S. Overhead Line Grounding: Comply with IEEE C2 except where stricter requirements are indicated. Use 2 or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.
1. Drive ground rods to a depth of 12 inches (300 mm) below finished grade in undisturbed earth.
  2. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.
  3. Lightning Arresters: Separate arrester grounds from other grounding conductors.
  4. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.
  5. Protect grounding conductors on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.
- T. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.

- U. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- V. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- W. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches (450 mm) below grade and 6 inches (150 mm) from the foundation.

### 3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
  - 2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
  - 3. Provide drawings locating each ground rod, ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Nominal maximum values are as follows:
    - a. Equipment Rated 500 kVA and Less: 10 ohms.
    - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    - c. Equipment Rated More Than 1000 kVA: 3 ohms.
    - d. Overhead Distribution Line Equipment: 25 ohms.
    - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    - f. Manhole Grounds: 10 ohms.

END OF SECTION 260526



## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of **five (5)** times the applied force.

#### 1.3 SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.
- C. Welding certificates.

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: **Steel** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti Inc.
    - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps and/or single-bolt conduit clamps using spring friction action for retention in support channel.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb. (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Provide an additional 20 metal supports with required fasteners of each size and type used on the project to accommodate any changes required to resolve interferences or directed by the Engineer.
- D. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches. (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

- B. Use 4000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete".
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint with a brush or spray to provide minimum dry film thickness of 2.0 mils. (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533 – RACEWAYS & BOXES

### 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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 26 Section "Underground Ducts" for exterior ductbanks, manholes, and underground utility construction.
  - 2. Division 26 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT (PVC): Electrical nonmetallic tubing.
- C. FAC: Flexible armored conduit.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible metal conduit.
- H. RMC: Rigid Metal Conduit.
- I. RNC (PVC): Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 METAL CONDUIT AND TUBING

- A. Manufacturer:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 4. Electri-Flex Co.
  - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
  - 6. LTV Steel Tubular Products Company.
  - 7. Manhattan/CDT/Cole-Flex.
  - 8. O-Z Gedney; Unit of General Signal.
  - 9. Wheatland Tube Co.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
  - 1. Fittings: Compression type up to 1-1/2 in. conduit, 2 in. and larger use set screw type.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

## 2.3 NONMETALLIC CONDUITS AND FITTINGS

### A. Nonmetallic Conduit:

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. AFC Cable Systems; a part of Atkore International.
  - b. Anamet Electrical, Inc.
  - c. Arnco Corporation.
  - d. CANTEX INC.
  - e. CertainTeed Corporation.
  - f. Lamson & Sessions.
  - g. RACO; Hubbell.
  - h. Thomas & Betts Corporation; A Member of the ABB Group.

### B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

### C. Nonmetallic 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. AFC Cable Systems; a part of Atkore International.
  - b. Anamet Electrical, Inc.
  - c. Arnco Corporation.
  - d. CANTEX INC.
  - e. CertainTeed Corporation.
  - f. Lamson & Sessions.
  - g. RACO; Hubbell.
  - h. Thomas & Betts Corporation; A Member of the ABB Group.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Pipe Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.4 METAL WIREWAYS

### A. Manufacturer:

1. Hoffman.



2. Square D.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, plastic edge covers, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- E. Wireway Covers: Screw cover type, Flanged and gasketed type at exterior.
- F. Finish: Manufacturer's standard enamel finish.

## 2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with the manufacturer's standard grey finish coat.
  1. Manufacturer:
    - a. Legrand
    - b. Panduit.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.
- C. Surface Non-Metallic Raceways: Polyvinyl with snap-on covers. Finish with manufacturer's light ivory color. Note, see drawings for locations where acceptable, provide metallic unless noted otherwise.
  1. Manufacturer:
    - a. Hubbell Inc.
    - b. Legrand
    - c. Panduit
- D. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.
  1. Single channel polyvinyl (raceway for branch circuit power and/or low potential services shall be Premise Trak (Latching) as manufactured by Hubbell.
  2. The two-piece single channel shall consist of a base section, 5 feet length, latching snap on cover, 0.38 in 2 channel base. Provide 1-gang or 2-gang boxes as required. Apply channel with mechanical fasteners. Adhesives and tapes are NOT acceptable.
  3. Two channel polyvinyl raceway for branch circuit power and low potential services shall be Wall Trak as manufactured by Hubbell.
  4. The two-piece, two channel raceway shall consist of a base section, 5 feet length, latching snap on cover, 0.81 in 2 and 0.79 in 2 channel bases. Provide 1-gang or 2-gang boxes as required. Apply base with mechanical fasteners. Adhesives and tapes are NOT acceptable.

## 2.6 BOXES, ENCLOSURES, AND CABINETS

### A. Manufacturer:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Com.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

### B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

### C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

### D. Floor Boxes: Cast metal, fully adjustable, rectangular.

### E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

### F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

### G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

### H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

## 2.7 FACTORY FINISHES

### A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard gray paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

#### A. Outdoors:

1. Exposed: Rigid galvanized steel: RMC or IMC.

2. Concealed: Rigid galvanized steel or IMC.
3. Underground, Single Run: RMC or RNC.
4. Underground, Grouped: RMC or RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or 4.

B. Indoors:

1. Exposed: EMT, surface metal raceway.
2. Concealed: EMT, FAC, FMC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid galvanized steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
  - a. Damp or Wet Locations: NEMA 250, Type 4.

C. Minimum Raceway Size: 3/4-inch trade size (DN 21)

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 26 Section "Hangers & Supports."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Provide an additional one hundred feet of raceway and accessories of each type and size used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

- I. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
  - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - 2. Space raceways laterally to prevent voids in concrete.
  - 3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 4. Change from nonmetallic tubing to Schedule 40 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.
  
- J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
  
- K. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - 1. Use insulating bushings to protect conductors.
  
- L. Terminations:
  - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
  
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
  
- N. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
  
- O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.

- P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- Q. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- R. Provide five additional boxes (floor, junction, etc.) and accessories of each size and type used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.
- S. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- T. Set floor boxes level and flush with finished floor surface.
- U. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- V. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

### 3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 260533

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Polymer concrete handholes and boxes with polymer concrete cover.

#### 1.2 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
1. Two or more ducts installed in parallel, with or without additional casing materials.
  2. Multiple duct banks.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
  - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
  - b. Include duct entry provisions, including locations and duct sizes.
  - c. Include cover design.
  - d. Include grounding details.
  - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
- C. Source quality-control reports.
- D. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

#### 2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Acceptable Manufacturer:
  - 1. ARNCO Corp
  - 2. Cantex Inc.
  - 3. Certain Teed Corp.
  - 4. Condux Internations, Inc.
  - 5. Crown Line Plastics
  - 6. ElecSys, Inc.
  - 7. Electri-Flex Co.
  - 8. Lamson & Sesions
  - 9. National Pipe & Plastics
  - 10. Or equal
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- D. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 FLEXIBLE NONMETALLIC DUCTS

- A. HDPE Duct: Type EPEC-40 HDPE, complying with NEMA TC 7 and UL 651A.
  - 1. ABB, Electrification Products
  - 2. ARNCO Corp.
  - 3. National Pipe & Plastics
  - 4. Premier Conduit
  - 5. Or equal
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

## 2.4 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
  - 1. ABB, Electrification Products
  - 2. Allied Tube & Conduit
  - 3. Cantex Inc.
  - 4. IPEX USA LLC
  - 5. PenCell Plastics
  - 6. Underground Devices, Inc.
  - 7. Or equal
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

## 2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Acceptable Manufacturers:
  - 1. Armorcast Products Co.
  - 2. MacLean Highline
  - 3. Oldcastle Infrastructure
  - 4. Quazite, Hubbell Inc. (Basis of Design)
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.



- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.6 SOURCE QUALITY CONTROL

- A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  1. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.

- C. Duct for Electrical Branch Circuits: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.
- D. Bored Underground Duct: Type EPEC-40 HDPE unless otherwise indicated.
- E. Underground Ducts Crossing Paved Paths and Walks direct-buried unless otherwise indicated.
- F. Underground Ducts Crossing: Driveways, Roadways and Railroads: RNC Type EPC-40 PVC, encased in reinforced concrete.
- G. Stub-ups: Concrete-encased RNC and GRC.

### 3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

### 3.4 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36" when used for Fiber Optic Cable, both horizontally and vertically, at other locations unless otherwise indicated.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to

environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf (1000-N) test nylon cord in empty ducts.
- L. Concrete-Encased Ducts and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
  - 2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
  - 3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
  - 4. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  - 5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
  - 8. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - 9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Concrete Cover: Install a minimum of .3 inches. (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches. (50 mm) between duct of like services, and .4 inches. (100 mm) between power and communications ducts.
12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

M. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than .6 inches. (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches. (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches. (75 mm) wider than duct on each side.
4. Depth: Install top of duct at least .18 inches. (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per .20 feet. (6 m) of duct. Place spacers within .24 inches. (600 mm) of duct ends. Stagger spacers approximately .6 inches. (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
9. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to .4 inches. (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
  - a. Place minimum .3 inches. (75 mm) of sand as a bed for duct. Place sand to a minimum of .6 inches. (150 mm) above top level of duct.
  - b. Place minimum .6 inches. (150 mm) of engineered fill above concrete encasement of duct.

- N. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks and approximately 6" below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

### 3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and brick masonry pavers and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

### 3.6 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum .12-inch- (300-mm-) long mandrel equal to duct size minus .1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
  - 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### 3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

END OF SECTION 260543

## SECTION 260553 – ELECTRICAL IDENTIFICATION

### 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 electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Provide product data information on products used.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

### PART 2 - PRODUCTS

#### 2.1 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - 1. Color: Black letters on orange field.
  - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Consider alternatives before specifying self-adhesive products in the paragraph below. See Editing Instruction No. 1 in the Evaluations.
- E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than .3 mils thick by 1 to 2 inches wide. (0.08 mm thick by 25 to 51 mm wide).
- F. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick. (152 mm wide by 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

G. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

H. Aluminum, Wraparound Marker Bands: Bands cut from .014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

## 2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum .1/16 inch. (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and .1/8 inch. (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. .1/4-inch. (6.4-mm) grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with .0396-inch. (1-mm) galvanized-steel backing; and with colors, legend, and size required for the application. .1/4-inch. (6.4-mm) grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

## 2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: .3/16 inch. (5 mm).
2. Tensile Strength: 50 lb. (22.3 kg) minimum.
3. Temperature Range: Minus 40 to plus 185 deg F. (Minus 40 to plus 85 deg C).
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.



4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches (51 mm) high, stenciled with paint at 10-foot (3-m) intervals over a continuous, painted orange background. Identify the following:
  1. Entire floor area directly above conduits running beneath and within 12 inches (305 mm) of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
  2. Wall surfaces directly external to conduits concealed within wall.
  3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
  4. Entire surface of exposed conduits.
- F. Install painted identification according to manufacturer's written instructions and as follows:
  1. Clean surfaces of dust, loose material, and oily films before painting.
  2. Prime surfaces using type of primer specified for surface.
  3. Apply one intermediate and one finish coat of enamel.
- G. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
  1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
  2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
  3. Apply the following colors to the systems listed below:
    - a. Fire Alarm System: Red.
    - b. Fire-Suppression Supervisory and Control System: Red and yellow.
    - c. Combined Fire Alarm and Security System: Red and blue.

- d. Security System: Blue and yellow.
  - e. Mechanical and Electrical Supervisory System: Green and blue.
  - f. Telecommunication System: Green and yellow.
- H. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- I. Circuit Identification Labels on Boxes: Install labels externally.
- 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
  - 2. Concealed Boxes: Plasticized card-stock tags.
  - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- K. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder, and branch-circuit phase conductors:
- 1. 208/120-V Conductors:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 2. 480/277-V Conductors:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow
  - 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
    - a. Colored, pressure-sensitive plastic tape in half-lapped turns for 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply the last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
    - b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- L. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
  2. Tag Fasteners: Nylon cable ties.
  3. Band Fasteners: Integral ears.
- M. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
  3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- N. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
  2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
  2. Access doors and panels for concealed electrical items.
  3. Electrical switchgear and switchboards.
  4. Emergency system boxes and enclosures.
  5. Disconnect switches.
  6. Enclosed circuit breakers.
  7. Motor starters.
  8. Push-button stations.
  9. Power transfer equipment.
  10. Contactors.
  11. Remote-controlled switches.
  12. Control devices.
  13. Transformers.
  14. Power-generating units.
  15. Telephone switching equipment.
  16. Clock/program master equipment.
  17. Fire alarm master station or control panel.

END OF SECTION 260553

## SECTION 260923 – LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching and dimming controls.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy and vacancy sensors
6. Digital timer light switches.
7. High-bay occupancy and vacancy sensors.
8. Outdoor motion sensors.
9. Lighting contactors.

##### B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Data, including technical specifications.
- B. Field quality-control reports.
- C. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

#### 1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturer's
  - 1. Hubbell Control Solutions
  - 2. Intermatic, Inc.
  - 3. Lutron
  - 4. Watt Stopper, Legrand
  - 5. Or equal.
- B. General Requirements for Sensors:
  - 1. Ceiling-mounted, solid-state indoor occupancy sensors.
  - 2. Dual technology (ultrasonic and passive infrared).
  - 3. Integrated power pack.
  - 4. Hardwired connection to switch.
  - 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 6. Operation:
    - a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
  - 8. Power: Line voltage.
  - 9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  - 10. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  12. Bypass Switch: Override the "on" function in case of sensor failure.
  13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc. (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of .6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than .36 sq. in. (232 sq. cm).
  2. Detection Coverage in spaces that are less than 800 square feet (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a .96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage in spaces that are greater than 800 square feet (Corridor, Ceiling Mounted): Detect occupancy within .90 feet (27.4 m) when mounted on a .10-foot- (3-m-) high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than .12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of .12 inches/s. (305 mm/s).
  2. Detection Coverage in spaces less than 800 square feet (Standard Room): Detect occupancy anywhere within a circular area of .1000 sq. ft. (93 sq. m) when mounted on a .96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage in spaces greater than 800 square feet (Large Room): Detect occupancy anywhere within a circular area of .2000 sq. ft. (186 sq. m) when mounted on a .96-inch- (2440-mm-) high ceiling.
- E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of .6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than .36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than .12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of .12 inches/s. (305 mm/s).
  3. Detection Coverage in spaces less than 800 square feet (Standard Room): Detect occupancy anywhere within a circular area of .1000 sq. ft. (93 sq. m) when mounted on a .96-inch- (2440-mm-) high ceiling.
  4. Detection Coverage in spaces greater than 800 square feet (Large Room): Detect occupancy anywhere within a circular area of .2000 sq. ft. (186 sq. m) when mounted on a .96-inch- (2440-mm-) high ceiling.

## 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Used in spaces less than 200 square feet, unless otherwise specified.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  - 4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.

## 2.3 OUTDOOR MOTION SENSORS

- A. Manufacturer's:
  - 1. Hubbell Control Solutions
  - 2. Cooper Industries, Inc.
  - 3. Leviton Manufacturing Co.
  - 4. Watt Stopper, Legrand.
  - 5. Or equal.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Dual-technology (PIR and infrared) type, weatherproof. Detect occurrences of .6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
  - 3. Switch Rating:
    - a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
    - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  - 4. Voltage: Dual voltage, 120- and 277-V type.
  - 5. Detector Coverage:
    - a. Standard Range: 210-degree field of view, with a minimum coverage area of .900 sq. ft. (84 sq. m).
    - b. Long Range: 180-degree field of view and .110-foot (34-m) detection range.
  - 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from .10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  - 7. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.

8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F. (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

## 2.4 LIGHTING CONTACTORS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Manufacturer's:
  1. ABB, Electrification Products Division
  2. Allen Bradley/Rockwell Automation
  3. Square D, Schneider Electric USA
  4. Or Equal.
- C. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.
  1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## 2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.



- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual

occupied conditions. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  1. Upgrade Notice: At least 60 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train] Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

## SECTION 262416 – PANELBOARDS & SWITCHBOARDS

### 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 panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
  - 1. Lighting and appliance branch-circuit panelboards.
  - 2. Distribution switchboards.
  - 3. Transient voltage surge suppressor panelboards.
- B. Related Sections include the following:
  - 1. Division 26 Section "Fuses."

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switchboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard, switchboard, and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

- a. Enclosure types and details for types other than NEMA 250, Type 1.
  - b. Bus configuration, current, and voltage ratings.
  - c. Short-circuit current rating of panelboards and overcurrent protective devices.
  - d. UL listing for series rating of installed devices.
  - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Field Test Reports: Submit written test reports and include the following:
- 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard and Switchboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
- 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- F. Should the contractor submit any substitution (including other approved manufacturers) other than the specified product the contractor shall be responsible for all electrical, mechanical, structural, and architectural revisions as required to accommodate the installation of the substituted equipment at no additional cost to the owner.

## 1.5 QUALITY ASSURANCE

- A. Comply with NEMA PB 1.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of switchboards, panelboards and associated components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

## 1.7 EXTRA MATERIALS

- A. Keys: Four spares of each type of panelboard cabinet lock. Key all cabinets alike.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
    - a. Eaton Corp.; Cutler-Hammer Products.
    - b. Schneider Electric - Square D Co. (Basis of Design)
    - c. General Electric
    - d. Or equal

### 2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets as noted in the drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: For boxes more than 28 inches high, entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

- L. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads as noted on the drawings.
- M. Split Bus: Vertical buses divided into individual vertical sections.
- N. Gutter Barrier: Arrange to isolate individual panel sections.
- O. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device. Provide wire feed same size as feeder.
- P. Provide ARC Flash labeling as required by the National Electrical Code.

### 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- C. Contractor shall confirm from local utility company prior to submittal review of minimum symmetrical short circuit rating requirements within project site, should the contract documents differ the contractor shall submit and provide the greater rated value.

### 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- C. All panelboards shall be fully equipped with all branch breaker mounting assemblies.
- D. All panelboards shall be fully equipped with a grounding bus bar assembly which must be large enough to meet a minimum of 100% of the branch circuit quantities plus 10%.
- E. All panelboards shall be fully equipped with a neutral bus bar assembly which must be large enough to meet a minimum of 100% of the branch breaker quantities plus 10%.

### 2.5 CLASS 2 LIGHTING PANELS – WITH CONTROL SYSTEM

#### Lighting Control System

- A. The lighting control system shall consist of microprocessor-based control electronics with remotely operated circuit breakers mounted to a UL67 listed lighting panelboard interior and enclosed in a UL50 listed panelboard enclosure. The circuit breakers shall provide overcurrent protection, and have an AIR rating or series connected rating that meets or exceeds the fault current of the system to which the panelboard is being applied.
- B. Each master control panel shall meet or exceed the following capabilities:

1. Sixteen (16) 2-wire input terminals for connection to external low voltage switch contacts.
  2. Time of day scheduling to automatically shut off lighting at specific programmed times
  3. Direct control of branch circuits in a master/slave sub-net configuration.
  4. Provide true status feedback by monitoring branch circuit breaker status based on actual system voltage at load side terminal.
  5. Accept remote commands through the facilities Ethernet infrastructure.
- C. All lighting control components shall be installed in a conventional panelboard 20 inches wide or column-width enclosures (as noted on drawings). Suitable barriers shall be installed to separate Class 2 wiring from power conductors.

## 2.6 DISTRIBUTION SWITCHBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike. Door-in-door construction.
- B. Main Overcurrent Protective Devices: Circuit breaker as noted. Main lugs only unless otherwise noted.
- C. Branch overcurrent protective devices shall be one of the following:
1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
  2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.7 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
  2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for ALL heating, air-conditioning, and refrigerating equipment.
  3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Lock-on clips: Install on circuit breakers for alarm, telecommunications, control systems, and refrigeration equipment.
7. Shunt Trip Device: Integrally mounted relay and trip unit with manual reset ONLY. In addition to the designated locations indicated on the contract documents it shall be required to provide a shunt trip device for any/all elevator and escalator equipment and systems. All elevator and escalator shunt trip devices shall be installed per the ASME A17.1 Safety Code for Elevators and Escalators.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- E. Install filler plates in unused spaces.
- F. Provide ONE additional panelboard and accessories of each size and type used on the project to accommodate changes required to resolve interferences or as directed by the Engineer.
- G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate mounted with corrosion-resistant screws.



### 3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match the original finish.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

#### 1.3 DEFINITIONS

- A. GFCI or GFI: Ground-Fault Circuit Interrupter.
- B. SPD: Surge Protection Device
- C. TVSS: Transient Voltage Surge Suppressor.

#### 1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. Maintenance Data: For materials and products to be included in maintenance manuals specified in Division 1.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
  - 1. Floor Service-Outlet Assemblies: One for every 20, but not less than one.
  - 2. Toggle switches with occupancy sensors: One for each five installed but not less than two.
  - 3. TVSS Receptacles: One for each eight installed, but not less than two.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Wiring Devices:
    - a. Hubbell, Inc.; Wiring Devices Div.
    - b. Killark Electric Manufacturing Co.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour/Legrand; Wiring Devices Div.
  - 2. Wiring Devices for Hazardous (Classified) Locations:
    - a. Crouse-Hinds Electrical Co.; Distribution Equipment Div.
    - b. Killark Electric Manufacturing Co.
    - c. Pyle-National, Inc.; an Amphenol Co.
  - 3. Multioutlet Assemblies:
    - a. Airey-Thompson Co.
    - b. Legrand/Wiremold Division.

### 2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

- C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.
  - 1. Devices: Listed and labeled as isolated-ground receptacles.
  - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- D. TVSS Receptacles: Duplex type, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.
  - 1. TVSS Components: Multiple metal-oxide varistors; rated a nominal clamp level of 500 transient-suppression voltage and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
  - 2. Active TVSS Indication: Light visible in face of device to indicate device as "active" or "no longer active."
  - 3. Identification: Distinctive marking on the face of device denotes TVSS-type unit.
- E. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.
- F. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

### 2.3 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.
  - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
  - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

### 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
  - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

### 2.5 CORD REELS

- A. A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: GFCI type device, Nylon body. Match cord and receptacle type for connection.
3. Reel: 15 Amp rated, 125V, with 25 linear feet of retractable cable (Hubbell model #HBL45123C). Provide mounting assembly as required for complete installation.

## 2.6 SWITCHES

- A. Snap (toggle) Switches: Heavy-duty, quiet type (single, 3-way and 4-way).
  1. Switch: 20 A, 120/277-V ac.
  2. Switch with occupancy sensing: 20 A, 120/277-V ac. Passive infrared compatible with LED and CFL lamps, adjustable time delay of 20 seconds to 30 minutes, 0 – 1000 watt lighting control, manual bypass control.

## 3.1 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: .04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
  3. Material for Unfinished Spaces: Galvanized steel.

## 3.2 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Raceway Material: Nonmetal.(accepted in office areas only)
- D. Wire: No. 12 AWG.

## 3.3 FLOOR BOXES FOR ON-GRADE AND ABOVE-GRADE CONCRETE FLOORS

- 1 Configurations: Boxes shall be available in one-, two-, or three-gang configurations or a single unit with two to eleven independent wiring compartments and available in stamped steel, epoxy coated stamped steel, nonmetallic and cast-iron versions. Boxes shall be available in deep and shallow versions. Boxes shall provide pre- and post-pour adjustments. Multiple gang boxes shall also provide a removable barrier between

the individual compartments for greater capacity when required. Refer to Drawings for size and types.

- a. Acceptable Product: Resource RFB4 Series Boxes for Concrete Floors by Legrand/Wiremold.
- b. Acceptable Product: Resource RFB4E-OG Series Shallow Epoxy Coated Stamped Steel Floor Boxes for Concrete Floors by Legrand/Wiremold.

2 Cover:

- a. Acceptable Product: FloorPort FPCT, FPBT, and FPFPT Series Covers: Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel, and brass). Activation covers shall be available in flanged and flangeless versions. Covers shall be available with options for tile or carpet inserts, or flush covers. The cover's hinge shall allow for the cover to open 180 degrees. The furniture feed covers shall come equipped with one 1-inch (25 mm) trade size screw plug opening and one combination 1-1/4 inches (32 mm) and 2 inches (52 mm) trade size screw plug.
  - 1) Flanged covers shall be 7-3/4 inches L by 6-9/16 inches W (197 mm by 167 mm).
  - 2) Flangeless covers shall be 6-3/4 inches L by 5-9/16 inches W (171 mm by 142 mm).

3 Metallic Floor Boxes:

- a. Material: Stamped steel and painted with a fusion-bonded epoxy; box interior and exterior painted; 1-3/8 inches (35 mm) pre-pour adjustment; 3/4 inch (19 mm) post-pour adjustment.
- b. Material: Epoxy coated cast iron; box interior and exterior painted; 1-3/4 inches (44 mm) pre-pour adjustment; 1/2 inch (13 mm) post-pour adjustment.
- c. Box Type: Rectangular.
- d. Service: Multiple.

3.4 MISCELLANEOUS WIRING CONNECTIONS AND COMPONENTS

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Raceway Material: Nonmetal.(accepted in office areas only)
- D. Wire: not less than the manufacturer's recommendation unless noted otherwise.
- E. Security Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents. Unless otherwise noted.

- F. IT Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents. Unless otherwise noted.
- G. Audio Visual Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents Unless otherwise noted.

### 3.5 FINISHES

- A. Color: Manufacturers standard, as selected by Architect.

## PART 3 - EXECUTION

### 4.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. All receptacles used for garage installations shall be GFIC type wiring devices.
- E. Do not share neutral conductor on load side of dimmers.
- F. Provide ten additional wiring devices (receptacles, TVSS, wallplates, switches, etc.) and accessories of each size and type used on the project to accommodate any changes required to resolve interferences.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Protect devices and assemblies during painting.
- I. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

### 4.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
- B. Comply with Division 16 Section "Basic Electrical Materials and Methods."
  - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.

2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on the face of plate and durable wire markers or tags within outlet boxes.

#### 4.3 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

#### 4.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Check TVSS receptacle indicating lights for normal indication.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

#### 4.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726



## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Motor-control centers.
  - c. Panelboards.
  - d. Switchboards.
  - e. Enclosed controllers.
  - f. Enclosed switches.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann, by Eaton
  2. Edison
  3. Littlefuse, Inc.
  4. Mersen USA

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.

4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
  5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
  7. Type T: 600-V, zero- to 1200-A rating, 200 kAIC, very fast acting.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

#### 3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
  - 1. Service disconnecting means.
  - 2. Feeder and branch-circuit protection.
  - 3. Motor and equipment disconnecting means.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.
  - 2. Division 26 Section "Panelboards and Switchboards" for individually enclosed, fusible switches used as feeder protection.
  - 3. Division 26 Section "Fuses" for fusible devices.

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
  - 1. 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. Enclosure types and details for types other than NEMA 250, Type 1.
  - b. Current and voltage ratings.
  - c. Short-circuit current rating.
  - d. UL listing for series rating of installed devices.
  - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in the "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
- 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
- 1. Routine maintenance requirements for components.
  - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
  - 3. Time-current curves, including selectable ranges for each type of circuit breaker.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA AB 1 and NEMA KS 1.
- D. Comply with NFPA 70.

- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F\_ (minus 30 deg C) and not exceeding 104 deg F\_ (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet. (2000 m).

## 1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## 1.8 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. Spares: For the following:
    - a. Potential Transformer Fuses-Provide an additional 6 fuses of each type utilized on this project.
    - b. Control-Power Fuses-Provide an additional 6 fuses of each type utilized on this project.
    - c. Fuses and Fusible Devices for Fused Circuit Breakers-Provide an additional 6 fuses of each type utilized on this project.
    - d. Fuses for Fused Switches-Provide an additional 10 fuses of each type utilized on this project.
    - e. Fuses for Fused Power-Circuit Devices-Provide an additional 10 fuses of each type utilized on this project.
  - 2. Spare Indicating Lights-Provide an additional 6 lights of each type utilized on this project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Fusible Switches:
  - a. Eaton Corp.; Cutler-Hammer Products.
  - b. General Electric Co.; Electrical Distribution & Control Division.
  - c. Siemens Energy & Automation, Inc.
  - d. Square D Co.
  
2. Molded-Case Circuit Breakers:
  - a. Eaton Corp.; Cutler-Hammer Products.
  - b. General Electric Co.; Electrical Distribution & Control Division.
  - c. Klockner-Moeller.
  - d. Siemens Energy & Automation, Inc.
  - e. Square D Co.
  
3. Combination Circuit Breaker and Ground-Fault Trip:
  - a. Eaton Corp.; Cutler-Hammer Products.
  - b. General Electric Co.; Electrical Distribution & Control Division.
  - c. Siemens Energy & Automation, Inc.
  - d. Square D Co.
  
4. Molded-Case, Current-Limiting Circuit Breakers:
  - a. Eaton Corp.; Cutler-Hammer Products.
  - b. General Electric Co.; Electrical Distribution & Control Division.
  - c. Siemens Energy & Automation, Inc.
  - d. Square D Co.
  
5. Integrally Fused, Molded-Case Circuit Breakers:
  - a. Eaton Corp.; Cutler-Hammer Products.
  - b. General Electric Co.; Electrical Distribution & Control Division.
  - c. Siemens Energy & Automation, Inc.
  - d. Square D Co.

## 2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, minimum 600V rated, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, minimum 600V rated, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

## 2.3 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
7. Molded-Case Switch: Molded-case circuit breaker without trip units.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
7. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

## 2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 2.5 FACTORY FINISHES

- A. Manufacturer's standard prime coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Provide an additional four branch breakers with enclosures and accessories of each size, phase and voltage as required to accommodate changes to resolve interferences or as directed by the Engineer.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods".
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### 3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.



- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
  - 2. Test continuity of each line- and load-side circuit.
- B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.
- C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
  - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
  - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches and circuit breakers checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match the original finish.

END OF SECTION 262816

## SECTION 262913 - ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes ac general-purpose controllers rated 600 V and less that are supplied as enclosed units.
- B. Related Sections include the following:
  - 1. Division 26 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.
  - 2. Division 26 Section "Fuses" for fuses in fusible switches.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
  - 1. 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. Enclosure types and details.
    - b. Nameplate legends.
    - c. Short-circuit current rating of integrated unit.
    - d. UL listing for series rating of overcurrent protective devices in combination controllers.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
  - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Field Test Reports: Written reports specified in Part 3.
- F. Manufacturer's field service report.
- G. Maintenance Data: For enclosed controllers and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
  - 1. Routine maintenance requirements for enclosed controllers and all installed components.
  - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.
- J. Should the contractor submit any substitution (including other approved manufacturers) other than the specified product the contractor shall be responsible for all electrical, mechanical, structural, and architectural revisions as required to accommodate the installation of the substituted equipment at no additional cost to the owner.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent testing agency with the experience and capability to satisfactorily conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain enclosed controllers 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.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, including clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subjected to weather, cover enclosed controllers to protect 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.

## 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
  - 2. Indicate method of providing temporary utilities.
  - 3. Do not proceed with utility interruptions without the Architect's written permission.

## 1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

## 1.8 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. Spare Fuses: Furnish three spares for every six installed, but not less than one set of three of each type and rating.

2. Indicating Lights: Two of each type installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Manual and Magnetic Enclosed Controllers:
    - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
    - b. Eaton Corp.; Cutler-Hammer Products.
    - c. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
    - d. Square D Co.
  2. Variable-Frequency Controllers:
    - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
    - b. Eaton Corp.; Cutler-Hammer Products.
    - c. MagneTek Drives and Systems.
    - d. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
    - e. Square D Co.

### 2.2 MANUAL ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

### 2.3 MAGNETIC ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch.
  1. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 10 tripping characteristic. Provide heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
- E. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 tripping characteristic, and selected to protect motor against voltage and

current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

- F. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:
  - 1. Compelling relay to ensure motor will start only at low speed.
  - 2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
  - 3. Decelerating relay to ensure automatically timed deceleration through each speed.
- G. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.
- H. Part-Winding Controller: NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.
- I. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.
- J. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
  - 1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
  - 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  - 3. LED indicators showing motor and control status, including the following conditions:
    - a. Control power available.
    - b. Controller on.
    - c. Overload trip.
    - d. Loss of phase.
    - e. Shorted silicon-controlled rectifier.
  - 4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.
  - 5. Motor running contactor operating automatically when full voltage is applied to motor.

## 2.4 VARIABLE-FREQUENCY CONTROLLERS

- A. The drive manufacturer shall supply the drive and all necessary options as specified herein. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and “brand labeled” shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a “brand labeled” drive. All VFDs installed on this project shall be from the same manufacturer.
- B. QUALITY ASSURANCE
  - 1. Institute of Electrical and Electronic Engineers (IEEE)
  - 2. IEEE 519-1992, Guide for Harmonic Content and Control.

3. Underwriters Laboratories (as appropriate)
    - a. UL508
    - b. UL508A
    - c. UL508C
  4. National Electrical Manufacturer's Association (NEMA)
    - a. ICS 7.0, AC Adjustable Speed Drives
  5. International Electrotechnical Commission (IEC)
    - a. EN/IEC 61800-3
  6. National Electric Code (NEC)
  7. NEC 430.120, Adjustable-Speed Drive Systems
  8. International Building Code (IBC)
  9. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156
- C. Qualifications:
1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR without the need for external input fuses.
  2. CE Mark – The base VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2). Base drives that only meet the Second Environment (Category C3, C4) shall be supplied with filters to bring the drive-in compliance with the First Environment levels.
  3. The entire VFD assembly, including the bypass (if specified), shall be seismically certified and labeled as such in accordance with the 2012 International Building Code (IBC):
  4. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
- D. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axes of motion.
- E. Description: NEMA ICS 2, pulse-width-modulated (minimum 8 pulse), variable-frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
- F. 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.
- G. Isolation Transformer: Match transformer voltage ratings and capacity to system and motor voltages; and controller, motor, drive, and load characteristics.
- H. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.
- I. Starting Torque: 100 percent of rated torque or as indicated.
- J. Speed Regulation: Plus or minus 1 percent.
- K. Ambient Temperature: 0 to 40 deg C.
- L. Efficiency: 95 percent minimum at full load and 60 Hz.
- M. Minimum Displacement Power Factor at Input Terminals: 95 percent.

- N. Isolated control interface allows controller to follow control signal over an 11:1 speed range.
1. Electrical Signal: 4 to 20 mA at 24 V.
  2. Pneumatic Signal: 3 to 15 psig\_ (20 to 104 kPa)..
- O. Internal Adjustability: Include the following internal adjustment 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 22 seconds.
  4. Deceleration: 2 to 22 seconds.
  5. Current Limit: 50 to 110 percent of maximum rating.
- P. 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.
- Q. Self-protection and reliability features shall include the following:
1. Input transient protection by means of surge suppressors.
  2. Snubber networks to protect against malfunction due to system voltage transients.
  3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
  4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
  5. Instantaneous overcurrent trip.
  6. Loss-of-phase protection.
  7. Reverse-phase protection.
  8. Under- and overvoltage trips.
  9. Overtemperature trip.
  10. Short-circuit protection.
- R. Automatic Reset/Restart: Attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor, or load.
- S. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
- T. 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.
- U. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.



- V. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.
- W. Manual Bypass: Magnetic contactor shall be arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass, selector-switch indicator lights set and indicate mode selection.
- X. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
- Y. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- Z. Isolating Switch: Non-load-break switch arranged to isolate variable-frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- AA. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

## 2.5 ENCLOSURES

- A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 2.6 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. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Elapsed Time Meters: Heavy duty with digital readout in hours.
- F. Meters for motors 25 horsepower or greater: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide a transfer device with an off position. Meters shall indicate the following:
  - 1. Ammeter: Output current, with current sensors rated to suit application.

2. Voltmeter: Output voltage.
  3. Frequency Meter: Output frequency.
- G. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- H. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

## 2.7 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

### 3.3 INSTALLATION

- A. See Division 26 Section "Basic Electrical Materials and Methods" for general installation requirements.
- B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Basic Electrical Materials and Methods."
- C. Install freestanding equipment on concrete bases complying with Division 3 Section "Cast-in-Place Concrete."
- D. Provide an additional two controllers with enclosures and accessories of each size, phase and voltage as required to accommodate changes to resolve interferences or as directed by the Engineer.

- E. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

### 3.4 IDENTIFICATION

- A. Identify enclosed controller components and control wiring according to Division 26 Section "Basic Electrical Materials and Methods."

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
  - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
  - 2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each enclosed controller bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.
  - 2. Certify compliance with test parameters.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting solid-state controllers.
- D. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

### 3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.9 CLEANING

- A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

### 3.10 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that enclosed controllers are installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.
- D. Complete installation and startup checks according to manufacturer's written instructions.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers and variable-frequency drives.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 262913

## SECTION 265100 – LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes the following types of LED luminaires:
  - 1. Cylinder.
  - 2. Downlight.
  - 3. Lowbay.
  - 4. Recessed linear.
  - 5. Strip light.
  - 6. Surface mount, linear.
  - 7. Surface mount, nonlinear.
  - 8. Suspended, linear.
  - 9. Suspended, nonlinear.
  - 10. Materials.
  - 11. Finishes.
  - 12. Luminaire support.

#### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
1. Provide point by point photometric design comparison for all areas.
- D. Product Schedule: For luminaires and lamps. Use the same designations indicated on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
- C. Product Certificates: For each type of luminaire.
- D. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five (5) years (including parts, labor and materials) from date of Substantial Completion.

### PART 2 - PRODUCTS

1. See Electrical Drawings for detailed lighting fixture schedule.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified[ and the luminaire will be fully operational during and after the seismic event]."

## 2.3 LUMINAIRE REQUIREMENTS

- 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. Standards:
  - 1. ENERGY STAR certified.
  - 2. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
  - 3. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
  - 4. UL Listing: Listed for damp location.
  - 5. Recessed luminaires shall comply with NEMA LE 4.
- C. CRI of minimum 70. CCT of 4000 K for exterior pole lights. 3500K for all interior lights, unless noted otherwise on the lighting fixture schedule.
- D. Rated lamp life of 50,000 hours to L70.
- E. Light fixtures shall have the ability to be dimmable minimum 0-10V.
- F. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- G. Internal driver.
- H. Nominal Operating Voltage: 120 V ac, 277 V ac (Universal) See drawings for specific application voltage.
  - 1. Lens Thickness: At least .0125-inch. (3.175 mm) minimum unless otherwise indicated.
- I. Housings:
  - 1. Die-cast aluminum unless specified otherwise.

## 2.4 CYLINDER

- A. See Electrical Drawings for detailed lighting fixture schedule.
- B. Include mounting bracket and/or assembly as required per the manufacturer's recommendations.

## 2.5 DOWNLIGHT

- A. See Electrical Drawings for detailed lighting fixture schedule.
- B. Universal mounting bracket.
- C. Integral junction box with conduit fittings.



D. Optics: As

## 2.6 LOWBAY

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Universal mounting bracket.

## 2.7 RECESSED LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

## 2.8 STRIP LIGHT

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

## 2.9 SURFACE MOUNT, LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

## 2.10 SURFACE MOUNT, NONLINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

## 2.11 SUSPENDED, LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

## 2.12 SUSPENDED, NONLINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

## 2.13 MATERIALS

### A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

### B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.

### C. Diffusers, and Globes:

### D. See Electrical Drawings for detailed lighting fixture information.

1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125-inch (3.175 mm) minimum unless otherwise indicated.

### E. Housings:

1. Die-cast-aluminum housing and heat sink, unless otherwise noted.

## 2.14 METAL FINISHES

### A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be, and are, assembled or installed to minimize contrast.

## 2.15 LUMINAIRE SUPPORT

### A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

### B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

### C. Rod Hangers: 3/8-inch minimum diameter, cadmium-plated, threaded steel rod.

### D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls or attached to a minimum 20 gauge backing plate or attached to wall structural members or attached using through bolts and backing plates on either side of wall unless specified otherwise.
  - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with pendant mounted all-thread.
- H. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stems and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 265100

## SECTION 265600 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

##### B. Related Requirements:

1. Section 16145 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 16522 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
- B. Shop Drawings: For nonstandard or custom luminaires.
  1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.

- C. Delegated-Design Submittal: For luminaire supports.
  - 1. Include design calculations for luminaire supports with wind load restriction up to 120 MPH.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale and coordinated. Signed and Sealed by a certified Professional Engineer registered in the State of New Jersey.
- B. Product Certificates: For each type of the following:
  - 1. Luminaire.
  - 2. Photoelectric relay.
- C. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
  - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.
  - 3. Provide As-Built Drawings including photometrics and shield requirements.

#### 1.6 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

#### 1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: five year(s) (including parts, labor, and materials) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 Approved Manufacturers:

- A. Kim Lighting (Basis of Design)
- B. Kenall Lighting (Basis of Design)
- C. Beacon Lighting (Basis of Design)

- D. Hess America Lighting (Basis of Design)
- E. Or Equal

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

## 2.3 LUMINAIRE REQUIREMENTS

- 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. Lamp base complying with ANSI C81.61 and IEC 60061-1.
- E. CRI of minimum 70. CCT of 4000 K, unless noted otherwise.
- F. L70 lamp life of 50,000 hours.
- G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- H. Nominal Operating Voltage: 120 V ac/208 V ac/240 V ac/277 V ac.
- I. Lamp Rating: Lamp marked for outdoor use.
- J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

## 2.4 LUMINAIRE TYPES

- A. Area and Site:
  - 1. Luminaire Shape: see lighting fixture schedule for fixture styles.
  - 2. Mounting: Pole (supplied with luminaire)
  - 3. Pole – Round (supplied with luminaire)
  - 4. Luminaire-Mounting Height: See Drawings.
  - 5. Distribution: See lighting fixture schedule for type and specific locations: Type 2, Type 3, Type 4, Type 5QM

## 2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Lens Thickness: At least 0.125-inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.

## 2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.



- a. Color: per owner selection. Provide color samples for owner approval.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and re-lamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
  - 5. Luminaire shall be able to withstand a minimum of 125 MPH wind load for a minimum of 60 seconds.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Conductors and Cables" and Section 260533 "Raceways and Boxes" for wiring connections and wiring methods.

### 3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on colored concrete base with top 30 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

### 3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 16130 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-52.
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Luminaire Pole: provide a certified wind testing report by the pole manufacturer states the pole can withstand a minimum wind load requirement as mandated by the latest edition of the International Building Code for the location the poles are being installed, but not less than 125 MPH (56 m/s).
- F. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to the lighting system, retest to demonstrate compliance with standards.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265600

## SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Category 5e twisted pair cable.
  - 2. Category 6 twisted pair cable.
  - 3. Category 6a twisted pair cable.
  - 4. Twisted pair cable hardware.
  - 5. Cable management system.

#### 1.2 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
  - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
  - 1. Cabling administration Drawings and printouts.
  - 2. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.
- C. Twisted pair cable testing plan.

- D. Field Quality-Control Submittals:
  - 1. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings cabling administration Drawings, and field-testing program development by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be always present when Work of this Section is performed at Project site.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

#### 1.5 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

#### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
  - 1. Communications, Non-Plenum Rated:
    - a. Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
  - 1. Flame-Spread Index: **25** or less.
  - 2. Smoke-Developed Index: **50** or less.

- C. RoHS compliant.

### 2.3 CATEGORY 5e TWISTED PAIR CABLE

- A. Description: Four-pair, balanced twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
  - 1. Cat 5e:
    - a. Beldon
    - b. GE
    - c. Leviton
- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP)
- F. Cable Rating: Riser
- G. Jacket: thermoplastic.

### 2.4 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
  - 1. Cat 6:
    - a. Beldon
    - b. GE
    - c. Leviton
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP)
- F. Cable Rating: Riser
- G. Jacket: thermoplastic.

## 2.5 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
  - 1. Twisted Pair Cable Hardware:
    - a. Beldon
    - b. GE
    - c. Leviton
- C. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of Category 5e/Category 6
  - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of the same category or higher.
- D. Connecting Blocks:
  - 1. 110-style IDC for Category 5e.
  - 2. 66-style IDC for Category 5e.
  - 3. 110-style IDC for Category 6.
  - 4. Provide blocks for the number of cables terminated on the block, plus **25** percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Plugs and Plug Assemblies:
  - 1. Male; eight positions; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Standard: Comply with TIA-568-C.2.
- F. Jacks and Jack Assemblies:
  - 1. Female; eight positions; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Designed to snap-in to a patch panel or cover plate.
  - 3. Standard: Comply with TIA-568-C.2.
- G. Cover Plate:
  - 1. Metal Cover Plate: Steel complying with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems."
- H. Legend:
  - 1. Machine printed, in the field, using adhesive-tape label.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF TWISTED PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. Routing: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.
- D. General Requirements for Cabling:
  - 1. Comply with TIA-568-C.1.
  - 2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Do not untwist twisted pair cables more than .1/2 inch. (12 mm) from the point of termination to maintain cable geometry.
  - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches. (760 mm) and not more than 6 inches. (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
  - 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:



1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

### 3.2 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

### 3.3 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- C. Comply with TIA-607-B and NECA/BICSI-607.
- D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- E. Bond metallic equipment to the grounding bus bar, using no smaller than a No. 6 AWG equipment grounding conductor.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Equipment grounding conductors.
- C. Cable and Wire Identification:
  1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
  3. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

- a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
  - b. Label each unit and field within distribution racks and frames.
4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- D. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Owner.
- B. Tests and Inspections:
1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and patch cords, and labeling of all components.
  3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Nonconforming Work:
1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
  2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. Collect, assemble, and submit test and inspection reports.

END OF SECTION 271513

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. 62.5/125-micrometer, multimode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Low-voltage control cabling.
7. Control-circuit conductors.
8. Fire alarm wire and cable.
9. Identification products.

1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- E. RCDD: Registered Communications Distribution Designer.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Pathways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

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

- B. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For pathways, accessories, and components, from manufacturer.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and maintenance data.

### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

### 1.7 PROJECT CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
  - 1. Indications that wire and cables are wet, or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 5e cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
- B. Cable Trays:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a business unit of Tyco Electrical & Metal Products.
    - b. Cablofil.
    - c. Cooper B-Line, Inc.
    - d. GS Metals Corp.
    - e. Snaketray; Cable Management Solutions, Inc.
  - 2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch. (0.012 mm) thick.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2 inches. (50 mm) wide, 3 inches. (75 mm) high, and 2-1/2 inches. (64 mm) deep.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

### 2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ADC.
  - 2. AMP Netconnect; a brand of Tyco Electronics Corporation.
  - 3. Belden CDT Networking Division/NORDX.
  - 4. Belden Inc.

5. Berk-Tek; a Nexans company.
6. CommScope, Inc.
7. Draka Cableteq USA.
8. Genesis Cable Products; Honeywell International, Inc.
9. Mohawk; a division of Belden.
10. Superior Essex Inc.
11. SYSTIMAX Solutions; a CommScope, Inc. brand.
12. 3M; Communication Markets Division.

B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
  - a. Communications, General Purpose: Type CM or CMG or CMP.
  - b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
  - c. Communications, Riser Rated: Type CMR; or CMP, complying with UL 1666.
  - d. Communications, Limited Purpose: Type CMX; or CMP,.
  - e. Multipurpose: Type MP or MPG; or MPP or MPR.
  - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
  - g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

## 2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, all hardware must be 100% compatible with cable type and transmission equipment:
1. ADC.
  2. American Technology Systems Industries, Inc.
  3. AMP Netconnect; a brand of Tyco Electronics Corporation.
  4. Belden CDT Networking Division/NORDX.
  5. Dynacom Corporation.
  6. Hubbell Incorporated; Hubbell Premise Wiring.
  7. Leviton Voice & Data Division.
  8. Molex Premise Networks; a division of Molex, Inc.
  9. PANDUIT CORP.
  10. Siemon.
- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- C. Connecting Blocks: 110-style for Category 5e or 66-style for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

## 2.5 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements:
1. AMP Netconnect; a brand of Tyco Electronics Corporation.
  2. Belden CDT Networking Division/NORDX.
  3. Berk-Tek; a Nexans company.
  4. CommScope, Inc.
  5. Corning Incorporated; Corning Cable Systems.
  6. CSI Technologies Inc.
  7. General Cable Technologies Corporation.
  8. Mohawk; a division of Belden.
  9. Superior Essex Inc.
  10. SYSTIMAX Solutions; a CommScope, Inc. brand.
  11. 3M; Communication Markets Division.
- B. Description: Multimode, 50/125 or 62.5/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
  2. Comply with TIA/EIA-568-B.3 for performance specifications.
  3. Comply with TIA-492AAAB or TIA-492AAAA-A for detailed specifications.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
  5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
  6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable, Orange for 62.5/125-micrometer cable.
  2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
  3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches. (1000 mm).

## 2.6 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
  2. American Technology Systems Industries, Inc.
  3. Belden CDT Networking Division/NORDX.
  4. Berk-Tek; a Nexans company.
  5. Corning Incorporated; Corning Cable Systems.
  6. CSI Technologies Inc.

7. Dynacom Corporation.
  8. Hubbell Incorporated; Hubbell Premise Wiring.
  9. Molex Premise Networks; a division of Molex, Inc.
  10. Siemon.
- B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
1. Quick-connect, simplex and duplex, Type SC, Type ST, Type LC, Type MT-RJ connectors. Insertion loss not more than 0.75 dB.
  2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.7 COAXIAL CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire Company.
  2. Belden CDT Networking Division/NORDX.
  3. Coleman Cable, Inc.
  4. CommScope, Inc.
  5. Draka Cableteq USA.
- B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CATV.
1. No. 14 AWG, solid, copper-covered steel conductor.
  2. Gas-injected, foam-PE insulation.
  3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
  4. Jacketed with sunlight-resistant, black PVC or PE.
  5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG-6/U: NFPA 70, Type CATV or CM.
1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
  3. Jacketed with black PVC or PE.
  4. Suitable for indoor installations.
- E. NFPA and UL Compliance: CATV Cable, Type CATV, or CATVP or CATVR shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles.



## 2.8 COAXIAL CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Emerson Network Power Connectivity Solutions; AIM Electronics brand.
  - 2. Leviton Voice & Data Division.
  - 3. Siemon.
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.9 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
  - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. Polypropylene insulation.
  - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  - 4. PVC jacket.
  - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
  - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. Plastic insulation.
  - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  - 4. Plastic jacket.
  - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  - 6. Flame Resistance: Comply with NFPA 262.

## 2.10 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM or CMG.
  - 1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
  - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  - 2. Fluorinated ethylene propylene insulation.
  - 3. Unshielded.
  - 4. Fluorinated ethylene propylene jacket.

5. Flame Resistance: NFPA 262, Flame Test.

## 2.11 LOW-VOLTAGE CONTROL CABLE

### A. Paired Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

### B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

## 2.12 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

## 2.13 FIRE ALARM WIRE AND CABLE

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (IMPORTANT: ALL FIRE ALARM CABLE SHALL BE PLENUM RATED CABLE: - NO EXCEPTION)

1. Comtran Corporation.
2. Draka Cableteq USA.
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corp.
5. West Penn Wire; a brand of Belden Inc.

### B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- C. Signaling Line Circuits: Twisted, shielded pair, not less than No.16 AWG size as recommended by system manufacturer.
  - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
  - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

#### 2.14 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. HellermannTyton.
  - 3. Kroy LLC.
  - 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

#### 2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (75 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors, and cables.

### 3.3 WIRING METHOD

- A. Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

### 3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 5e rating of components and that ensure Category 5e performance of completed and linked signal paths, end to end.
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Install 110-style IDC termination hardware unless otherwise indicated.
  - 3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- E. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568-B.3.
  - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- F. Outdoor Coaxial Cable Installation:
  - 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
  - 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- G. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of .8 inches. (200 mm) above ceilings by cable supports not more than 60 inches. (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of .5 inches. (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of .12 inches. (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of .24 inches. (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches. (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of .6 inches. (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of .12 inches. (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of .3 inches. (75 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of .6 inches. (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of .48 inches. (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of .5 inches. (127 mm).

### 3.5 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.

- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
  - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
  - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### 3.7 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Perimeter Security Systems" for connecting, terminating, and identifying wires and cables.

- B. Comply with requirements in Division 28 Section "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "Video Surveillance" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" for connecting, terminating, and identifying wires and cables.
- F. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.
- G. Comply with requirements in Division 28 Section "Refrigerant Detection and Alarm" for connecting, terminating, and identifying wires and cables.

### 3.8 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.9 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.10 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.11 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. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and patch cords, and labeling of all components.
  3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 280513

## SECTION 281300 - ACCESS CONTROL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. General description, functional requirements, operational characteristics, and criteria for the Security Management System (SMS).

#### 1.2 RELATED SECTIONS

- A. Section 8 – Door Openings
- B. Division 26 - Electrical: Electrical systems and components.
- C. Section 280513 - Conductors and Cables for Electronic Safety and Security.

#### 1.3 DEFINITIONS

- A. API: Application Programming Interface.
- B. ISC: Intelligent System Controller, also known as a Controller, Data Gathering Panel, field panel and other names. This device is essentially a circuit board that resides at the customer site and executes the actual grant/deny decisions allowing or denying cardholders entry.
- C. SMS: Security Management System.
- D. Text: Short Message System as it related to standard text message functionality on your mobile phone. – you may notice SMS used in connection with “Text Message” as it is frequently referenced as such outside of the United States.
- E. LDAP: Lightweight Directory Access Protocol, a software protocol allowing the location of individuals and other resources in a network.
- F. VM: Visitor Management, as it relates to the add-on module for the SMS.
  - 1. Restriction of the Use of Certain Hazardous Substances (RoHS) in Electronic Equipment

#### 1.4 SECURITY MANAGEMENT SYSTEM (SMS) DESCRIPTION

- A. The Security Management System (SMS) outlined in this section and detailed in Part 2 of is the key central component for managing physical access control and security. The system shall provide a variety of integral functions including controlling of access and egress; provisioning badges; monitoring, tracking and interface alarms; visitor management and view, and link video surveillance to SMS events.
- B. The SMS shall utilize a single seamlessly integrated document oriented, NoSQL database for all functions utilizing Mongo DB 4.0.11.
- C. Upgrades or expansion of the SMS to a larger size system in scale shall not require installation of a different and/or new SMS application or require the administrator or operator to learn a different and or new interface from the previous version.

- D. The SMS web client shall only require an OS application to access everything from Live Monitoring, Badge Layout and Design, Custom Attribute Editor, Floor plan/map creation to all other administrative and operational tasks. The SMS application shall run and be supported on Microsoft Windows 8.1+ Operating System (OS).
- E. The SMS software developer shall be a Microsoft Silver Certified Partner.
- F. The SMS software developer shall be an AWS Technology Partner.
- G. The SMS shall only require a single license key to be present on the database server for the SMS to operate. The cloud hosted model shall require no license installation by customer.
- H. The SMS shall be able to seamlessly interface with and monitor intelligent system controllers, reader interface modules, I/O panels, alarm panels, and digital video recorders approved for use by the SMS manufacturer.
- I. The SMS shall be able to communicate with intelligent system controllers Ethernet communications over both local area networks and/or the Internet.
- J. The system shall be accessible from any compatible browser on the network/Internet or OS application utilizing a cloud-based architecture hosted in AWS. There shall not be any middleware (software, hardware, or appliance) needed to connect from the hosted software to the access control hardware on site.
- K. Utilize an open architecture where all data must reside on a single database and must be accessible in real time to SMS workstation application or Web-based client connected to the network via the API. The system shall be configurable to support the following databases: Mongo DB 4.0.11.
- L. The SMS shall be able to connect to and interface bi-directionally with external data sources utilizing all the following methods:
  1. Web services built on REST (Representational State Transfer) HTML5 Services.
- M. The SMS shall support:

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.
  1. Manufacturer's technical data for all material and equipment at the system and sub system level to be provided as part of the SMS.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.
  1. Indicate all system device locations on architectural floor plans. No other system(s) shall be included on these plans.
  2. Include full schematic wiring information on these drawings for all devices. Wiring information shall include cable type, conductor routings, quantities, and connection details at device.
  3. Include a complete SMS one-line, block diagram.

- C. Operation and Maintenance Data: For electronic security system to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. SMS manufacturer shall be an established organization with referenced and documented experience delivering and maintaining SMS of equal or higher sophistication and complexity as compared to the system detailed in this specification.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
- B. Store components and equipment in temperature and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50- and 85-degrees Fahrenheit (10 and 29.4 degrees Celsius), and not more than 80 percent relative humidity, non-condensing.
- C. Open each package; verify contents against packing list; and file copy of packing list, complete with package identification, for inclusion in operation and maintenance data.
- D. Mark packing list with the same designations assigned to materials, components, and equipment for recording in the system labeling schedules that are generated by software.
- E. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

## 1.8 WARRANTY

- A. SMS, Third-party, and Access Control Warranty:
  - 1. SMS manufacturer warrants that the product download or hosted instance shall be free from defects in material and workmanship and that SMS software product will function in substantial accordance to SMS manufacturer's specifications.
  - 2. All SMS manufacturer branded access control hardware have one (1) year warranty from the date of shipment to the Reseller. SMS manufacturer warrants that such products will be free from defects in material and workmanship and that they will operate in general accordance with their product specifications.
  - 3. Transfer SMS third-party device warranties from the manufacturer to the Contractor, which may then transfer third-party warranties to the Owner. Specific third-party warranty details, terms and conditions, remedies, and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product.

## 1.9 SMS STARTUP and COMMISSIONING

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: The security management system is based on products of Feenics, Inc., 301-2310 St. Laurant Blvd, Ottawa, ON Canada. Web site: [www.Feenics.com](http://www.Feenics.com).

## 2.2 SMS SOFTWARE

- A. Security Management System (SMS) Software: Keep by Feenics

## 2.3 SMS FIELD HARDWARE

- A. (SMS) Hardware: The SMS shall be equipped with the access control field hardware required to receive events and execute access granted and denied decisions. Field hardware must be capable of accepting on the fly commands from System Operators. All field hardware must be designed to meet UL 294 requirements. Hardware must be industry standard non-proprietary and supported by a minimum of fifteen (15) other software manufacturers.

1. Intelligent System Controllers (ISC): FN-LP1501, FN-LP3202, FN-LP3200 and FN-LP4502. These previous versions of Intelligent Systems Controllers are still supported: FN-EP1501, FN-EP3202, FN-EP3200 and FN-EP4502.
  - a. Intelligent Single Door Controller: FN-LP1501
  - b. Intelligent Dual Reader Controller: FN-LP3202, FN-LP4502
2. Input Control Module (ICM): FN-16IN
3. Output Control Module (OCM): FN-16OUT
4. Single Reader Interface Module (SRI): FN-RIM1-S3
5. Dual Reader Interface Module (DRI): FN-RIM2-S3
6. Dual PoE Reader Interface Module: FN-RIM2e (OSDP only)
7. Communication Star Multiplexer: FN-MUX8, FN-M5-COM
8. The SMS shall be able to support the following Mercury bridge boards: M5 Bridge Field Panels and iStar Bridge Field Panels.
9. The SMS shall support ProWatch conversions that use PW61IC boards.
10. UL, CUL, and CE listed power supplies and enclosures

- B. SMS Card Readers and Wireless locksets:

1. Allegion/Schlage AD-400 wireless electronic access control lockset
2. Allegion/Schlage AD-300 hardwired access control lockset
3. Allegion/Schlage LE series wireless electronic access control lockset
4. Allegion/Schlage NDE series wireless electronic access control lockset
5. Allegion/Schlage Multi-Family Control locks
6. Allegion/Schlage Cards and Readers
7. ASSA Aperio Wireless locksets and readers
8. Farpointe Data Cards and readers
9. HID Proximity Readers
10. HID iCLASS SE card readers
11. HID iCLASS OSDP card readers
12. HID mobile-enable, mobile-ready card readers
13. HID pivCLASS card readers

- C. SMS Credential Printers: The SMS credential management module shall be compatible with Windows 8.1+ compatible print drivers.

- D. SMS Third-party Devices: The SMS shall interface with select devices from the following manufacturers:

1. Bosch® Intrusion Detection Panels (B3512, B4512, B5512, B6512, D9412GV4, D7412GV4, B9512G, and B8512G)
2. Salient CompleteView Video Management Systems
3. ExacqVision Video Management Software
4. Milestone Video Management Software
  - a. XProtect Corporate
  - b. XProtect Expert
  - c. XProtect Professional
  - d. XProtect Professional+
  - e. XProtect Express
  - f. XProtect Express+
  - g. XProtect Essential+
5. Amazon Simple Notification Service SMS/Text Notification
6. Pelco Video Expert
7. OpenEye OWS Video Management Software
8. Wavestore
9. OTIS Compass Destination Dispatch
10. KONE Destination Dispatch
11. ThyssenKrupp AGILE Destination Dispatch

## 2.4 SERVER AND WORKSTATION REQUIREMENTS

### A. Application/Database Servers

1. Database Servers
  - a. Windows Server 2016 Standard Edition
  - b. Quad Core Intel® CPU
  - c. 8GB RAM
  - d. 500GB Hard Drive for storage (expandable as required)
  - e. 10/100/1000 Ethernet Network Ports
  - f. Mongo 4.0.11 Relational Database Management
  - g. System shall be sized appropriately for the scope of the project.
2. API Servers
  - a. Windows Server 2016 Standard Edition
  - b. Quad Core Intel® CPU
  - c. 8GB RAM
  - d. 100GB Hard Drive for storage (expandable as required)
  - e. 10/100/1000 Ethernet Network Ports
  - f. System shall be sized appropriately for the scope of the project.
3. Mercury/Bosch/MDC Server
  - a. Windows Server 2016 Standard Edition
  - b. Quad Core Intel® CPU
  - c. 4GB RAM
  - d. 100GB Hard Drive for storage (expandable as required)
  - e. 10/100/1000 Ethernet Network Ports
  - f. System shall be sized appropriately for the scope of the project.

### B. Client Workstation Specifications for using Keep's Windows Desktop App (hosted)

1. Client Workstations shall use Windows 8.1 or Newer OS and must be currently supported by Microsoft.
  - a. Most currently available Intel Pentium class processor
  - b. 8 GB RAM

- c. 120GB hard drive
  - d. 10/100/1000 Ethernet Network Port
  - e. USB 2.0 ports if needed for photo capture
  - f. 17 in. Flat LCD Monitor
  - g. 64 MB Video Card
  - h. USB Keyboard & Mouse
- C. Client Workstations Specifications for using Keep's HTML 5 Web Client (hosted)
1. Client Workstations shall use Windows 8.1 or Newer OS, or fully supported version of MAC OS by Apple.
    - a. Currently available on the market Intel Pentium class processor
    - b. 4GB current RAM
    - c. 120GB hard drive
    - d. 10/100/1000 Ethernet Network Port
    - e. USB 2.0 ports if needed for photo capture
    - f. 17 in. Flat LCD Monitor
    - g. 64 MB Video Card
    - h. USB Keyboard & Mouse
    - i. Compatible browser
- D. Application must be hosted by Feenics using Amazon Web Services' EC2 Services.

## 2.5 COMPONENTS

- A. SMS Software Capabilities: Support an unlimited number of card readers, input points, video cameras, intrusion detection points, and relay outputs. The SMS database server shall support an unlimited number of cardholders, limited only by the available memory on the server. The database server shall also support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. The SMS functions are categorized into fifteen (15) primary "system modules" which shall include:
1. Access Control
    - a. One of the SMS's primary purposes shall be to provide access control. The SMS shall be able to make access granted or denied decisions, define access levels, and set schedules and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SMS shall support features such as area control (two-person control, hard, soft, and timed anti-passback), and schedule or holiday overrides.
  2. Live Monitoring
    - a. The Live Monitoring window shall provide information about the time and location of the alarm, along with its priority. The Live Monitoring window must be able to sort/filter pending and/or insert new alarms based on alarm attributes.
    - b. The SMS must allow unique emergency instructions to be specified for each type of alarm. It shall also allow for the automatic sending of alphanumeric SMS/text messages, and e-mail messages upon alarm arrival. A real-time graphical hardware list on the screen shall indicate if card readers, alarm panels, intrusion detection panels, or Intelligent System Controllers are secured, unsecured, in alarm, or offline. Output control operations must be available to lock, unlock or pulse control points as a standard feature. An operator Activity Log shall be available to log important daily events. A history function shall be available for System Operators to locate and track activity on specific cardholders, or card readers. All alarms and hardware icons must have the ability to control the associated hardware via right-mouse clicks.

3. AWS Cloud High Availability
  - a. The SMS shall support a high availability model in the AWS datacenters. SMS hosted solution shall provide for:
    - 1) Hourly transactional backups
    - 2) 24-hour full point in time recovery backups
    - 3) Automatic monthly software releases
    - 4) All server-side maintenance and patching
    - 5) Elastic block storage in AWS Cloud
    - 6) Inherent redundancy of cloud and datacenter communications
    - 7) Automatic archiving of data
    - 8) Periodic news and update information in SMS Welcome screen
4. Credential Management and Creation
  - a. The SMS shall include a seamlessly integrated credential management module in the application. The credential management functionality must allow the enrollment of cardholders into the database, capturing of images, as well as the import of employee data. This functionality shall also allow the System Operator to assign and/or modify the access rights of a cardholder. Credential Management module must be part of an OS application and single browser interface.
  - b. The SMS shall include a seamlessly integrated credential creation and production system. This shall allow for the creation of different badge types based on a database field, the linking of that field to a badge type to automate the process of credential production.
  - c. The SMS shall have the ability to capture photos with a built-in or USB camera, import photos as well as zoom, crop and save photos from the application.
  - d. The SMS shall have the ability to add HID mobile credentials using only the fields within the SMS, which is integrated to HID's ORIGO service in AWS.
5. Video Integration
  - a. The SMS shall include integration to third party Video Management systems such as Salient CompleteView, ExacqVision, OpenEye, Pelco VideoXpert, Wavestore, Milestone XProtect Corporate, Milestone XProtect Expert, Milestone XProtect Professional, Milestone XProtect Professional+, Milestone XProtect Express, Milestone XProtect Express+, Milestone XProtect Essential+, Avigilon. It shall support real-time linkage of digital video clips to their associated alarms as well as those from linked devices in the SMS database, Access Control hardware for example. This linkage shall happen automatically as defined by the configuration.
  - b. System Administrators shall define parameters for video segment creation by specifying pre-alarm and post-alarm durations. The system shall automatically associate alarms from linked hardware with the linked camera's pre- and post-alarm durations.
  - c. The SMS shall support the ability to click on a video icon in the Live Monitor and Event History interface and automatically launch the linked video clip.
  - d. Integration shall support the ability to acknowledge the event from the video player, download the clip, and have pan, tilt, and zoom control.
  - e. The SMS shall support Network Video Recorders from multiple manufacturers.
6. Visual Verification. The SMS shall have the ability to bring up card holder images upon use of credential at readers.
7. Intrusion Detection Management
  - a. The Intrusion Detection Management System shall provide advanced, seamless integration with Intrusion Detection Panels from Bosch (B3512, B4512, B5512, B6512, D9412GV4, D7412GV4, B9512G, and B8512G), allowing customers to monitor intrusion detection alarms inside the SMS Monitoring application, in



addition to giving System Operators command and control of supported intrusion detection devices (such as arming and disarming an area).

8. LDAP Integration
  - a. The Lightweight Directory Access Protocol integration shall provide advanced integration with Microsoft Active Directory, allowing customers to sync data on employees between Active Directory and Keep by Feenics.
9. Visitor Management
  - a. The Visitor Management System shall provide the ability to define visitors and visits. The Visitor Management System shall include a calendar for event creation, the ability to create visitors and assign badges for use during the visit, classify visitors, create companies and projects to organize visitors. The Visitor Management System shall provide a way to manage restricted access individuals to prevent the entrance of barred people.
10. Third-Party Interfaces
  - a. The SMS shall integrate with a number of third-party hardware and software products.
11. System Administration/Users
  - a. System Administrative tasks such as defining user roles & permissions, access levels, schedules, reports, maps, etc. shall be provided from in the OS application.
  - b. No licensing fee for unlimited, concurrent user licenses.
  - c. Single Sign-On (SSO) licensable option.
  - d. System Administrative tasks such as access levels, monitoring, schedules, and holidays shall be provided from the single browser interface.
12. Audit Logs. Changes to any field shall be tracked and recorded for audit trails.
13. Custom Forms
  - a. The SMS shall also allow System Administrators to add custom fields in addition to any standard fields from the OS application.
14. Floorplans/Graphical Map Creation
  - a. The SMS shall provide Graphical Floorplan Creation and Editing Software that must allow System Administrators to import customized map backgrounds of their facility and to attach custom icons to those maps. Graphical Floorplans shall be created in the Windows application.
  - b. Graphical Floorplans shall be scalable, and users must have the ability to zoom in and out to provide focus on a particular area.
  - c. Graphical Floorplans shall have the ability to be referenced by readers to allow opening of the graphical floorplan during an alarm event.
15. Application Programming Interfaces
  - a. The SMS shall provide a set of standard Application Programming Interfaces (API's) that allows hardware manufacturers and software application developers to integrate their products. The Application Programming Interfaces shall be built on REST.
  - b. The SMS shall support a real time, bi-directional data interface to external databases such as Human Resources, Time and Attendance and Student Information Systems. The interface shall allow data to be transferred in or out of the SMS in real-time or in a batch mode basis.
16. Data Import
  - a. The SMS shall support an import utility that will allow the customer or VAR to import cardholder information into the SMS database. This shall allow the customer or VAR to pre-populate the SMS database with existing cardholder data and/or add new records to the existing SMS database. The CSV import shall include both standard fields and user definable fields.
17. Desination Dispatch

- a. The SMS shall support Destination Dispatch that will allow for the customer to use the card holders from the SMS to determine cab and destination in the given destinatin dispatch system. Support includes Otis, Kone and ThyssenKrupp.
- B. SMS Software Functionality:
1. Schedules:
    - a. The SMS shall be capable of creating and storing up to 255 schedules per intelligent system controller. Each interval shall be assignable to any day of the week.
    - b. Each schedule shall be assignable to an alphanumeric name. Schedule shall be applied to access levels, card reader modes, alarm inputs, alarm outputs, system events, and logging functions. Schedules shall be allowed to belong to any or all access levels so that the schedule need only be defined once.
    - c. Schedules that span the day/time boundary (midnight) shall only need be defined by a single interval. Requiring two intervals to span midnight shall not be acceptable.
  2. Access Levels:
    - a. Capable of defining up to 32,000 access levels with up to 128 access levels per cardholder. Access levels shall consist of a combination of card readers, card holders, schedules and.
    - b. Each access level shall be assignable to an alphanumeric name using up to 64 characters. holidays
    - c. Card readers shall have the ability to be assigned to any or all access levels defined in the SMS. Individual card readers shall be capable of having a distinct schedule assigned to it.
    - d. Allow a 'First Person In' – mode change option to be assigned on a per Reader Basis.
  3. Temporary Access Levels:
    - a. Each Temporary Access Level shall be definable with a start and end date.
    - b. Temporary Access Levels shall be stored in the ISC and functionality shall be maintained in the event of disconnection with the ISC.
  4. Badge Types:
    - a. The SMS shall be capable of assigning default Access Levels directly to Badge Types.
    - b. The SMS shall be capable of setting default expiration dates to cards assigned under a specific badge type.
    - c. The SMS shall be capable of assigning a default badge layout/design to the Badge type if cards are to be printed.
  5. Holidays:
    - a. The SMS shall provide a minimum of 255 Holiday assignments. Holidays shall be assigned an alphanumeric name using up to 64 characters and shall be assignable to individual schedule intervals. Access rights and card reader modes must be able to be altered when the current date is designated a Holiday.
    - a. MASTER Holiday scheduling can be administered at the root partition to pollinate down to all sub instances.
    - b. Dates for Daylight Saving Time changes shall be defined at the server and update automatically.
    - c. The SMS shall support Holiday Ranges that allow a single holiday to span across multiple calendar days.
    - d. The SMS shall contain an automatic "Holiday Generator" such that system administrators can simply select from specific US state and Canadian provincial holidays.
  6. First Person In: Feature that when configured prohibits a scheduled unlock/mode change command until a valid credential has been presented and granted access to the reader. First

Person In shall require a valid cardholder with proper “Management Level” to first enter the area.

7. Database Partitioning: Support data partitioning whereby each partition shall have its own set of field hardware and system parameters (schedules, access levels etc.). This partition shall expand the limitations of the SMS parameters (that is, access levels and schedules) to the maximum capacity of each parameter multiplied by the number of segments. The following list shall be made available for segmentation:
  - a. Access Levels
  - b. Alarm Inputs
  - c. Alarm Outputs
  - d. Areas
  - e. Badge Types
  - f. Card Formats
  - g. Card Readers
  - h. Holidays
  - i. Intrusion Detection Panels
  - j. ISCs
  - k. Maps
  - l. Schedules
  - m. System Operators
  - n. User Permission Groups
8. Field Hardware Communications:
  - a. The SMS shall communicate with the ISCs by the following protocols:
    - 1) TCP/IP. Legacy forms of communication to the server such as serial communication shall not be accepted.
  - b. Only outbound port 3001 or 443 shall be necessary for the ISC to communicate to the server. Absolutely no inbound ports shall be required to be open to preserve IT security.
  - c. Download communication between the SMS and the ISC shall be fully multi-tasking and shall not interfere with operational functions.
  - d. Upon loss of communications between the SMS Server and the ISC, an alarm shall be created with a time stamp. Upon re-established communication, the SMS and the ISC shall automatically re-synchronize from the point of communication loss without operator intervention.
  - e. The server shall authenticate the panel on its MAC address.
9. Intelligent System Controller Encryption to SMS
  - a. Data security for encrypted connections between SMS and Intelligent System Controllers shall be provided by Transport Layer Security (TLS).
10. Open Supervised Device Protocol (OSDP)
  - a. The SMS shall provide connectivity to readers that support the SIA OSDPv2 protocol which provide continuous supervision and monitoring of reader processor and wiring integrity by means of a non-proprietary communications protocol standard.
11. Area Control: Provide five (5) area control features: Local Hard Anti-passback, Local Soft Anti-passback, Timed Anti-passback, Two Person Control, and Occupancy Limit. Area control shall be a security method of preventing a person from passing their badge to another person for dual entry into a single location utilizing one (1) card.
  - a. Local Hard Anti-passback: Requires that a badge always be used to enter and exit an area. The controlled areas must have both entry and exit card readers at all ingress/egress points. Entry and Exit Readers must be connected to the same ISC.

- 1) Areas shall be logically defined under the SMS, and area control shall not be required at all areas of facility. A cardholder must present their badge at the entry card reader of the area that the person wishes to enter. Once access has been granted into the area, the cardholder cannot present the badge to another entry card reader within the same area without first presenting badge to the respective exit card reader of that area.
- 2) Should a cardholder attempt to use any other card reader in the same area besides the occupied area's exit card reader once access has been granted to that area, the cardholder shall be denied access, and an alarm shall be reported to the monitoring client.
- b. Local Soft Anti-passback Feature: Functions the same as Hard Anti-passback with the exception of anti-passback violations. Soft anti-passback will only trigger an alarm and will not deny a badge holder with proper access levels from gaining entry.
- c. The following summary criteria shall apply under Hard or Soft Anti-passback:
  - 1) Initially (Time 0) all cardholders are reset to Area 0.
  - 2) Any cardholder shall enter a controlled area any time after Time 0 by presenting a badge to an SMS entry card reader.
  - 3) A cardholder shall not exit the controlled area unless he or she has entered the area presenting a badge to the SMS entry card reader.
  - 4) A cardholder shall not enter the controlled area a second time unless the cardholder has exited that area previously.
  - 5) A cardholder shall be able to enter through any entry card reader and exit through any exit card reader of a single controlled area.
  - 6) These options shall include a "forgiveness" feature that will allow the System Administrator to reset the anti-passback of all cardholders to Time 0 Area 0.
  - 7) The SMS provides an anti-passback exemption option for cardholders. Cardholders with this option will not have anti-passback rules applied to them.
- d. Timed Anti-passback: Permits the System Administrator to decide how long after a cardholder has swiped their badge that they will have to wait before the same badge will be accepted again at the same card reader. This helps prevent multiple swipes by an individual to allow access to others through turnstile doors.
- e. Two Person Control: Provided to restrict access to certain areas unless there are two (2) cardholders present. This restricts individuals from gaining access alone to highly secure areas. When an area is configured for Two Person Rule, the following criteria shall prevail:
  - 1) The card reader will grant access only if two (2) valid cardholders (with authorized access levels) swipe their badges one after the other. In the event that a second authorized card is not presented within 10 seconds of the first authorized badge, the card reader shall reset, and the first card will have to be swiped again.
  - 2) Once two (2) people occupy an area, individual access shall be granted.
  - 3) Individual exit shall be permitted until an area is occupied by only two (2) cardholders at which point the Two Person Rule applies for exit.
- f. Occupancy Limit: Restricts the number of cardholders that can be present in an area at any given time. Once the occupancy limit has been reached, a cardholder must swipe out of the exit card reader before the next cardholder may enter.
  - 1) Each area for which the Occupancy Limit is enabled shall be definable with up to 64 entry or exit card readers with proper ISC.
  - 2) Area must be defined by readers connected to same ISC.

- 3) Multiple Occupancy Limit Areas shall be definable.
12. Airlock group readers
 

The SMS shall have Airlock/Interlock support. In the Controller Area configuration, there shall be an option to make an area an interlock area. Interlocked areas shall be able to be configured, allowing only one door to be opened at a time within the local area. This function shall only be able to be enabled for local anti-passback.

The SMS shall support interlocking group readers. As soon as one door's strike is energized or door is open in the group, all other doors will be denied access until a condition is met. When the SMS administrator creates an area with the Interlock set, when one door strike of the area is active or if the door is open, then no door shall be allowed to open and there shall be an alarm.

There shall be an alarm for when access is denied due to interlock reader group.
  13. Field Hardware Configuration: All field hardware configuration windows shall be accessed from either the SMS hardware list, the SMS folder explorer or from menu options in the menu bar within the SMS configuration module of the software. When a field hardware device is configured, the device shall appear in the hardware list, folder explorer and in all appropriate forms.
 

Configuration of all field hardware and shall be provided in the OS application.

    - a. Graphical System List controls for ease of navigation and use
 

The SMS shall have the ability to add, modify, and delete privileges for ISCs and card readers to allow for the ease of addition and maintenance of these field hardware devices.
  14. Extended Grant Access Times: Support Extended Grant Access Times that allows a card reader's strike to be active for an extended period beyond the pre-determined standard strike time on a per cardholder basis. The extended strike time is user-definable up to 255 seconds. Extended strike times are to be set on a card reader by card reader basis. This shall help customers meet US ADA compliance.
  15. Extended Door Held Open Times: The SMS supports Extended Door Held Open Times that allows a card reader's door to be held open for an extended period beyond the pre-determined standard held open time on a per cardholder basis.
  16. Manager Level: Only those cardholders having specific "Manager Levels" at a given card reader shall be able to toggle reader modes by presenting a valid card twice (known as double tap) and/or execute First Person In functionality.
  17. Elevator Control:
    - a. The SMS shall provide elevator control using standard Mercury access control field hardware that will permit the restriction of cardholder access to certain floors while also allowing general access to other floors. The elevator control feature shall allow, at the elevator, the use of any card reader and all card reader modes used on any other card reader in the SMS. Each elevator card reader shall control access for a minimum of 128 floors.
    - b. Schedules shall be configurable per floor.
    - c. System Users shall be able to pulse/activate specific floors from the OS application and single browser interface.
    - d. The SMS shall be able to track which floor was selected by an individual cardholder for auditing and reporting purposes.
  18. Alarm or Event Logging: All alarms and events in the SMS shall by default, always be recorded in the database.
  19. Card Formats: Support an unlimited number of card formats per system. Magnetic stripe and Wiegand card formats shall be supported. Each ISC shall support up to sixteen (16) access control card formats. As such, each card reader shall also be able to support a maximum of sixteen (16) access control card formats. The SMS shall support any magnetic

stripe format that uses card number, facility code, and issue code combinations with a maximum of a nineteen (19) digit card number.

- a. The system shall pre-define the most commonly used formats such as:
  - 1) HID 26 bit (H10301)
  - 2) HID Corporate 1000 35 bit
  - 3) HID Corporate 1000 48 bit
  - 4) HID Managed 37 bit
  - 5) Allegion Cardtrax
  - 6) Allegion 37H, no facility code
  - 7) Andover Infinity 37 bit
20. Card Reader Schedule Overrides:
  - a. Allow for the pre-defined default card reader settings to be overridden or temporarily changed on a schedule basis. At the beginning of a selected schedule, the selected card reader's operational mode shall be modified from its default mode to any one of the following modes: card only, PIN only, card and PIN, card or PIN, facility code only, unlocked, and locked down.
  - b. Each card reader shall have the ability to have multiple schedule setting overrides assigned to them as required by the System Administrator.
21. Tool Tip Help: SMS provides help in the form of mouse over tool tips.
22. Alarm Attributes: The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis. Each alarm and/or event shall have the option(s) to:
  - a. Allow higher priority alarms to be displayed in the live monitoring client workstation ahead of lower priority alarms.
  - b. Automatically send an e-mail message.
  - c. Automatically send an SMS/Text Message.
  - d. Have the alarm highlighted in a specific color with specific priority.
  - e. Execute a Local I/O Trigger and Procedure.
23. System Downloads:
  - a. The SMS shall provide for the downloading of data to the ISCs. Downloads shall load SMS information (schedules, access levels, alarm configurations, etc.) into the ISCs first, followed by cardholder information and card reader configurations.
  - b. All ISCs on the SMS shall be capable of either full or selective downloads to individual Intelligent System Controllers and bi-directionally so that alarms will still report as cardholder information is being downloaded.
  - c. Information on cardholder status, badge status, schedules or access levels shall be downloaded in real time as they are added, modified, or deleted from the SMS.
24. Simulated Card Reads: System Administrators shall have the ability to simulate a badge reader at a door by sending the specific badge number and facility code to the controller. This will run the system through a full cycle similar to the badge actually be presented. If and only if the user has access to that door will they be granted access. This function will authenticate all the standard access control rules at the door such as access level, time, date and holiday. This allows Administrators to troubleshoot and test to see if a door is working and if specific badges were downloaded to the panel.
25. Card Reader Options: Include the following options for each reader on the system:
  - a. Independently Supervise REX and DPS
  - b. Configure REX and DPS as Normally Open or Normally Closed
  - c. Deny if Duress
  - d. Assume Door Used
  - e. Anti-passback Control
  - f. Do Not Activate Strike on REX

- g. Allow for user-definable door strike functionality for each card reader in the SMS.
  - h. Alarm Shunt: The SMS shall have the ability to shunt a door contact of separate intrusion detection systems. When the SMS provides an access granted a dedicated auxiliary output shall first trigger and bypass the door contact of the separate intrusion detection system, and then the door locking mechanism shall unlock. Once the door returns to a secure state the door contact of the separate intrusion detection system shall return to its normal state.
26. Input Control Module (ICM) Options: Provide the following options for the Input Control Modules:
- a. Local Linkage: The ability to locally link outputs with inputs that are attached to the same ICM or Output Control Module (OCM).
  - b. Configuration of Debounce Times: The ability to control the amount of time that an input state change must remain consistent for it to be considered a real change of state.
  - c. Configuration of Hold Times: When configuring an Alarm Input, a hold time setting shall be settable from 0-15 seconds.
  - d. Supervised Input: The ability to specify if a specific alarm contact on the ICM is a supervised or unsupervised contact.
27. Entry or Exit Delay: The ability to set up entry or exit delays for inputs that are attached to any ICM, SRI, or DRI. System Administrators shall have three options for entry or exit delay:
- a. Non-Latched Entry: When an input activates, the alarm will not be reported until the Entry delay expires. If the input is still active when the entry delay expires, the alarm will be reported. If the input is not active when the entry delay expires, then the alarm will not report.
  - b. Latched Entry: When an input activates, the alarm will not be reported until the Entry delay expires. If the input is still active when the entry delay expires and the alarm has not been masked, the alarm will be reported. If the input has been masked when the entry delay expires, then the alarm will not report.
  - c. Exit Delay: When an input activates, the alarm will not be reported (operates as if masked) until the Exit delay expires. If the input is still active when the exit delay expires, the alarm will be reported. If the input is not active when the exit delay expires, the alarm will not be reported.
28. Wireless Readers & Locks
- a. SMS shall be capable of fully integrating wireless reader/lockset devices directly to industry standard intelligent systems controllers.
  - b. Locks shall be available in 1:16 and 1:8 wireless hub to lock ratios.
  - c. Locks shall be able to “wake up” and receive commands from the System Operator in order to change state within 10 seconds.
  - d. Locks shall be available in both cylindrical and mortise form factors.
  - e. Locks shall be capable of emergency lockdown from inside the secure area.
  - f. Locks shall transmit up to 1000 feet with a clear line of site and approximately 100 feet inside a building.
29. Strike Follower
- An output for a reader can be overridden so that it is configured to activate and deactivate timed with a door strike. It can be set for a delay time and/or pulse.
- There shall be a mode called "Strike Follower". The mode shall be optional and mutually exclusive with alarm shunt and tailgate. Strike Follower shall override the auxiliary 1 output and shall allow the output to follow the strike pulse. It shall be configurable with a delay and a pulse time.
- The settings shall include:

- a. Activation delay
  - b. Mode: Pulse or Follower
  - c. Pulse time: When a pulse is used, a pulse time can be specified.
30. Visitor Management and Creation: The SMS shall allow the System Operator to create Visitors to the system. The SMS shall allow for the classification of visitors to facilitate the correct escort requirements, access levels and badging for the visitor. The system shall allow the addition of ID photos, signature, and custom data fields for visitors. The SMS shall provide an automated log of visitor creation.
31. Visit Creation and Management: The SMS shall allow for the creation of events in a calendar view to manage the visits in the system. The SMS shall provide a way for the System Operator to add a host, visitors, location, date and time of the event to take place. This SMS shall also allow the System Operator to change the visitor status from the calendar view (check in, check out and confirm). The SMS shall provide an automated log of visit creation and visitor status. The SMS shall provide a visit list view that allows the System Operator to view a list of visits for a selected day. This list shall include the name of the visitors, the time of their visit, their visitor classification, and status. This list menu should also allow for the change of status without navigating away from the page.
32. Live Monitoring - Alarms Monitored: The SMS shall allow for the monitoring of a combination of one or more ISCs, ICMs, alarm inputs, alarm outputs, and card readers. If applicable, the SMS shall also allow the monitoring of a combination of video cameras and intrusion detection devices. Live Monitoring shall be configured to annunciate any or all of the following types of alarms: access granted alarms, access denied alarms, system alarms, emergency alarms, and/or area control alarms.  
Live Monitoring shall be accomplished through the OS application and the single browser interface and shall be in real time.
33. Alarm Annunciation Configuration: The System Administrator shall have the capability to configure how the SMS handles the annunciation of alarms on an individual alarm or event basis. Each alarm and/or event shall have the option(s) to:
- a. Display in Live Monitoring.
  - b. Allow higher priority alarms to be displayed Live Monitoring ahead of lower priority alarms.
  - c. Automatically link event video from a network video camera
  - d. Allow the System Operator to control network video camera functions including pan, tilt, zoom, focus.
  - e. Require System Operator acknowledgment to clear.
  - f. Allow mandatory journal entry upon acknowledgment.
  - g. Automatically send an e-mail message to one or more e-mail recipients.
  - h. Automatically send an SMS/Text message to one or more recipients
  - i. Have the alarm appear in the Live Monitoring window with a colored bar across it for high priority alarms based on its priority. Each priority in the SMS shall have its own unique color assigned to it. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.
  - j. Insert and display alarms based on sort order. System Operators can sort alarms based on alarm priority, time, date, alarm description, requires acknowledge, card reader, alarm input device, ISC, cardholder, and if applicable, central station alarm receiver, transmitter, or transmitter input.
  - k. Allow the System Operator to be able to find the location of the alarm by using a graphical map, the real-time graphical status list, or an alarm menu.
34. Alarm Handling: The handling of alarms shall resemble the following steps.



- a. The System Operator shall select the alarm or event by any one of the following procedures:
    - 1) Clicking with the mouse on the system device map icon representing the alarm
    - 2) Choosing 'acknowledge' from the menu bar
    - 3) Highlighting the alarm or event in the alarm list by clicking the mouse
    - 4) Double-clicking on the alarm or event in the alarm list box
    - 5) Acknowledging from the video player after selecting the video clip.
    - 6) Acknowledging from a Mobile App.
  - b. Any of the above choices shall put the System Operator in the acknowledgment window. The acknowledgment window shall display the time, date, and a user-defined description of the alarm, as well as any emergency procedures. The acknowledgment window shall present the System Operator with the following choices:
    - 1) Make a journal entry
    - 2) Acknowledge the alarm
    - 3) Review any previous journal entries for this alarm.
- Until the alarm is acknowledged, the alarm shall remain in the Live Monitoring Window.
- 35. Current Status Indication: The Hardware View window shall provide a visual status that displays the current status of all devices in the device list including child devices downstream from the primary device. Additionally, there shall be a numeric display of card readers, ISCs and ICMs that are offline.
  - 36. Monitor Multiple Systems from Single Workstation: SMS allows administrators to monitor multiple systems each through a single application session on a single workstation.
  - 37. Favorites: Most system objects shall be able to be added to the System Operators Welcome/Home screen. System Operators shall be able to open, view history, run reports, activate and more on objects in the favorites such as:
    - a. People
    - b. Readers
    - c. Outputs
    - d. Inputs
    - e. Reports
    - f. Triggers and Procedures
    - g. Schedules
    - h. Access Levels
  - 38. Welcome Page/Home Screen: System Operators shall be able to add Favorites to help with usability and system ease of use.
    - a. Welcome screen shall also display recent manufacturer news such as release information, release notes and video tutorials to aid with system adaptation and user experience.
  - 39. Color Coding for Alarm Priorities: Display alarms in the active Live Monitor window and Event History window with a colored bar across the alarm based upon priority. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.
  - 40. Inactive Badge Alarm: The SMS shall provide an alarm, indicating current badge status, if an attempt to gain access is made with a badge that has a status set to any value other than "Active" in the cardholder record. Typical inactive badge status values include "Deactivated" and "Deleted". Access shall be denied for this attempt.
  - 41. Request to Exit Event: The SMS shall provide an event when a Request to Exit (REX) is used.
  - 42. Single Button Lockdown: The SMS shall include a docked icon that shall execute a single button lockdown for a group of readers specified by the System Administrator. System

- Operators shall be able to perform lockdowns by Access Level, by reader and from the Hardware Status Window.
43. Mass Notification: The system shall support a basic Mass Notification feature available from the OS application. In the case of an emergency such as a lock down, System Administrators shall be able to click on a single icon and notify groups of cardholders such as:
    - a. Cardholders. (Default Option)
    - b. Cardholders by Access LevelBoth Email and Text Message Notification shall be available.
  44. System History: Cardholder, Card Reader, or any Field Hardware Device History: From the OS application or single browser interface, the System Operator must be able to initiate an Event History of cardholders, alarms and/or field hardware devices while monitoring alarms.
    - a. Event History shall be filtered based on time frame of data desired, priority of events, message, event type and if acknowledgement is required.
    - b. Event History shall operate independently of each other and the System Live Monitoring Window. Thus, different Alarm Filter sets shall be settable for each alarm window (Main Live Monitoring Window and Event History Windows) open in Live Monitoring. For example, the Live Monitoring window may not monitor Access Grants Events, while one or more of the trace windows are monitoring Access Grants Events.
    - c. System Operators shall be able to print reports to PDF, Excel, or a print preview screen directly from both Live Monitoring and Event History Windows.
  45. Manual Control: Provide the System Operator with the option to manually control over all output points or input points connected to the SMS. Control points are defined as any door strike, auxiliary card reader output, or any other relay output point of an Output Control Module (OCM).
  46. Real-Time, Graphical Floorplans/Maps:
    - a. Support graphical maps from the OS application that display device status dynamically in real-time. Map device icons shall have the ability to show alarm status.
    - b. Support all map formats listed below:
      - 1) Graphics Interchange Format (.gif)
      - 2) JPEG (.jpg)
      - 3) Port Net Graphics (.png)
    - c. Support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously.
    - d. The SMS shall also give System Operators the ability to affect the mode of card readers, open doors, start a trace on a device, mask or unmask alarm inputs, and activate or deactivate or pulse an output from the map icons.
  47. Real-Time Hardware View Window: The SMS shall support a real-time graphical list or list window that graphically depicts all field hardware devices that are configured in the SMS. The real-time graphical list window shall display all ISCs, ICMs, alarm inputs, relay outputs, card readers and intrusion devices.

The List Window shall display all hardware devices separately in their own row in the window. The following columns shall exist in the list window:

    - a. Icon Image
    - b. Device Name
    - c. Current Device Status
    - d. Device Connected To

System Operators shall be able to sort any column in ascending or descending order. System Operators shall also have the ability to choose what types of devices to display in the Hardware View window. The following choices shall be available:

- e. Include All Devices
- f. Include Specified Devices:
  - 1) Controllers
  - 2) Reader Interface Modules
  - 3) Readers
  - 4) Inputs
  - 5) Outputs
  - 6) Intrusion Panels and devices.
- g. A Filter window shall also be available to enable System Operators to quickly type in text and only see devices that match.

The SMS shall allow System Operators to affect the access mode of card readers, open doors, view Event History on a device, and activate or deactivate or pulse an output from the list icons.

- 48. Alarm Filtering: Have the capability for filtering out alarm types from the Live Monitoring window. Alarms are filtered by type, message, time and date, and priority. If applicable, intrusion detection alarms, and video tailgating alarms may also be filtered.
- 49. List Filtering: Any lists in the browser interface shall have a Filter Feature that allows System Operators to quickly sort through large lists of data such as people, readers, and other hardware devices.
- 50. Manual Override of Card Readers: Support System Operator overrides of card readers from the Live Monitoring window, graphical maps, or the Hardware View list. Also supports the ability to manually set a reader back to default mode.
- 51. Manual Overrides of Alarm Points and Relay Outputs: The SMS shall support System Operator overrides of alarm points and relay outputs configured in the SMS. System Operators shall have the ability to manually mask or unmask an alarm point and/or activate, deactivate, or pulse a relay output from the Live Monitoring window, Floorplans, or the real-time Hardware List Window.
- 52. SMS/Text Message: Support a text message interface seamlessly integrated within the SMS Monitoring application. System Operators shall have the ability to send alphanumeric messages manually or automatically on demand regarding any alarm currently displayed in the Live Monitoring window. Text Messages shall have the ability to be sent to multiple devices if desired.
- 53. E-mail Interface Option: Support an e-mail interface seamlessly integrated within the SMS Monitoring application. System Operators shall have the ability to configure alarms to automatically send e-mail messages. E-mails shall have the ability to be sent to multiple e-mail accounts if desired.
- 54. Personnel Management and Enrollment:
  - a. The SMS shall generate and store personnel records, as well as monitor badge or credential use throughout the facility. These credentials shall be fabricated from the OS application or single browser interface and configured based on data and images that are input and captured at enrollment. Credential images are to be digitally stored and printed using a high quality and direct card printing process.
  - b. Create and Maintain Cardholder Database: A record for each cardholder shall be created in the SMS by entering the required data into appropriate data fields.
  - c. Once all fields have been entered, the SMS shall store the applicant's record to the SMS database. Updating cardholder data shall be possible at any time by any authorized System Operator.

- d. A SMS data import function shall be available to pre-load the SMS with personnel records. This import function shall be capable of adding records to the database at any time.
  - e. Only System Operators with editing privileges (assigned by the System Administrator) shall be able to edit records. Deleting a record shall permanently remove the record from the database (including image files).
  - f. The System Operator shall have the following functions available when enrolling cardholders: choose a badge type, select access levels, enter personal identification numbers (PIN), and/or any other Custom Attributes.
  - g. The cardholder's current Badge information shall also be displayed on the cardholder form complete with Badge ID number, activation and deactivation date and time.
55. Cardholder Active Badges: A cardholder may possess one or many badges at any one time. Each cardholder record shall offer a user-definable activation and expiration date field. The activation date shall be changed by a System Operator to establish a future activation date. A System Operator shall be able to re-activate a card that has been previously de-activated. When issuing a new badge to a cardholder, System Operators shall be able to assign the pre-existing badge deactivation date and time to the badge instead of the default deactivation date and time for new badges. The deactivation date and time may be assigned on a per badge type basis.
- A badge form will keep a complete history of every badge that was assigned to the cardholder's record. The history shall be complete with cardholder badge ID, badge type, badge status, activation and deactivation dates and times.
56. Global Search:
- a. The SMS shall support a comprehensive global search which allows system users to search all objects and attributes in the database.
  - b. The SMS shall support regex logic searches (greater than, greater than or equal to, less than, less than or equal to, equal to).
57. Enrollment and Credential Creation - Enrollment:
- a. System Operators shall be able to enroll cardholders on a one-by-one basis. System Operators will fill in all required fields including name and badge type. The SMS shall determine a number of attributes based on the cardholder's badge type. These attributes shall be:
    - 1) Default Deactivation Date or Time - The deactivation date or time shall have the ability be set for a pre-determined number of days, months, or years, or for an exact specified date.
    - 2) Default Access Levels
    - 3) Badge Design Layout
    - 4) Which Printer will Produce the Badge
    - 5) Information and Encoding Format to be Encoded onto the Magnetic Stripe
  - b. System Operators shall also enter a Badge ID of up to 18 digits for the cardholder. The cardholder Badge ID shall be manually entered by the System Operator. System Operators shall have the option of utilizing PIN Codes of up to fifteen digits (15) and anti-passback exemptions for each cardholder who is enrolled in the SMS.
58. Cardholder Image Capture: Ability to import/capture photos from the OS application or single browser interface.
- a. Compatible with built in web cameras and attached USB cameras.
59. Image Import: Allow System Operators to have the ability to import a cardholder's image at the time of enrollment. The SMS must support the following image formats:
- a. Bitmaps (.bmp, .dib)
  - b. JPEG (.jpg)
  - c. Portable Network Graphics (.png)

60. Badge Design: Support the ability to create and maintain badge designs from the OS application.
  - a. Complete Badge design and Layout tools
  - b. Use of an “Expression Editor” such that system users can easily link fields on the card to the database fields such as “First Name” and “Last Name.”
  - c. Image Import
  - d. Bar code support
  - e. Link badge design to specific Badge Types
61. ID Printers: The SMS shall support double-sided full color printing on those printers in which double-sided full color printing is available. The SMS shall also support edge to edge printing on those printers in which edge to edge printing is available. The SMS shall support high-speed printing on those printers in which high speed printing is available.
62. Bar code Support: Support the following bar codes:
  - a. Verify QR Code
  - b. Code EAN 13 Checksum
  - c. Code EAN 8 Checksum
  - d. Code 11
  - e. Code 11 Checksum
  - f. Code 128 Checksum
  - g. Code 25 Standard
  - h. Code 25 Standard Checksum
  - i. Code 25 Interleaved
  - j. Code 25 Interleaved Checksum
  - k. Code 39
  - l. Code 39 Checksum
  - m. Code 93 Checksum
63. Integrated Intrusion Detection Interface:
  - a. Provide seamless integration with intrusion detection panels. This shall allow for the ability to monitor intrusion detection alarms in real time inside the SMS Monitoring application and allow for command and control of supported intrusion detection. Once alarms are brought into SMS, they shall have the ability to be viewed, controlled, and they shall be stored in the SMS database.
  - b. Ability to disarm zones and areas in the Intrusion Detection system based on a valid card read in the SMS.
  - c. Ability to set keypad display messages in the Intrusion Detection “alarm panel”.
  - d. The following intrusion detection panels shall be supported with Bosch GV4:
    - 1) Bosch D9412GV4
    - 2) Bosch D7412GV4
    - 3) Bosch B9512G
    - 4) Bosch B8512G
    - 5) Bosch B3512
    - 6) Bosch B4512
    - 7) Bosch B5512
    - 8) Bosch B6512
  - e. Communication with the intrusion detection panel shall be achieved through a LAN connection.
  - f. Intrusion detection panel devices (zones, relays) shall be definable and added to the SMS database.
  - g. Allow for the configuration of Intrusion Detection Zones, Areas, Relays and Doors. Operators shall have the ability to mark intrusion detection Zones, Areas, Relays and Doors as ‘enabled’ or ‘disabled’.

- h. Report status information for the Intrusion Detection Devices.
  - i. Support the ability to display events that have occurred on the Intrusion Detection Panel as well as report any incoming events that occur on the panel while the panel is online.
64. System Administration
- All System Administration activities must be available through the OS application and shall not require the installation of another software module.
- a. System Configuration  
The SMS shall provide system icons and/or menu selections for each function requiring configuration of SMS options or peripherals (client workstations, field hardware, network functions, communications, reports, etc.). Icon tools bars shall be viewable or hidden.
  - b. Password Privileges
    - 1) Each Person assigned a system user role must have a password. System users will be restricted by user or user group permissions. Specific System Operator restrictions shall include:
      - a) Access to screens or functions (for example: live monitoring, badge issue)
      - 2) Specific tasks allowed (for example: Read, update, delete, etc.)If a System Operator is denied access to specific functions, those functions shall not appear.
  - c. System Operators  
The SMS shall support an unlimited number of System Operators at any time. Each System Operator shall be assigned a logon ID and password. Each System Operator shall be assigned permission levels for system administration and configuration functions, Credential Management functions, live monitoring functions, digital video management functions, and database field viewing options.  
Administrators shall be able to grant any Person in the system operating permissions. Administrators shall not be required to add a Person (most likely one that has a card) a second time in order for them to have login privileges.
  - d. System Permissions  
Every major feature, function, and cardholder page in the SMS shall be permission protected. Each System Operator shall be assigned permission or no permission to use or view or access each feature and function in the SMS. Permission groups shall have seven (7) options:
    - 1) Create
    - 2) Read
    - 3) List
    - 4) Update
    - 5) Delete
    - 6) Take Ownership
    - 7) Publish
  - k. System Operator Activity Logging  
The SMS shall provide full System Operator activity tracking. The activity log shall be comprehensive, recording the date and time of the activity, the System Operator who performed the activity, the program the activity occurred in, and the function that was performed within it. The SMS shall record any and all changes to the database made by System Operators.  
The number of events to keep online shall only be limited by the amount of disk space available on the database server.  
The SMS shall provide the System Operator with the ability to query the above information and shall allow the System Operator to sort the report.
  - l. Alarm or Event Activity Logging

The SMS shall provide full access or alarm or event activity logging. The activity log shall provide comprehensive logging of date and time of the transaction, where the transaction occurred, acknowledgment information, and any System Operator actions.

65. PIN Numbers

The SMS shall have the ability to support up to fifteen (15) digit PIN Numbers for each card in the SMS. PIN Numbers shall be created either manually through System Operator entry or generated randomly by the SMS. The SMS shall have the ability to be configured to allow for unique PINs for each cardholder and the ability to modify cardholder's PIN numbers at a later date.

66. Event Archives

The SMS shall allow System Administrators to automatically archive live data to history files in the AWS Cloud or locally. History files shall include access events and System Operator transactions that have been purged from the reportable database. Days to keep online and in Archive shall be definable from the OS application and single browser interface.

Reports shall be generated from the archived files if necessary. Archiving shall be a scheduled, automatic function.

67. Floorplans Creation

The SMS shall support graphical floorplans/map creation tool that is part of the OS application that shall allow the import of map backgrounds from some standard graphic formats listed below:

- a. Bitmaps (.bmp)
- b. JPEG (.jpg)
- c. Portable Network Graphics (.png)

These architectural type maps must allow the detailed layout of an entire structure, part of a structure, a floor or department within a building, or layout of the periphery of a facility. Once a map has been imported, the System Administrator must have the ability to place system level icons of card readers, input and output points, video cameras, and other access control field hardware in the appropriate area to indicate their respective location on the map. This is to be accomplished by simply dragging the icon with the mouse to the appropriate location on the map.

Maps shall also support user-defined text that shall be placed onto the map background.

68. Bulk Person Import Module: The SMS shall support an import utility, which shall allow the Customer or VAR to import cardholder information into the SMS database from a CSV file. This shall allow the Customer or VAR to pre-populate the SMS database with existing cardholder data and/or add NEW records to an existing SMS database.

69. SMS Server Resiliency

a. The Cloud Hosted SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below:

- 1) Hourly Transaction backups and one-year's worth of rolling transactions
- 2) Daily full backups
- 3) Elastic Block Storage
- 4) Distributed Intelligence

b. Distributed Architecture

In the event SMS communications is lost, Intelligent System Controllers shall provide complete control, operation and supervision of all monitoring and control points. The ISC shall be configured with a UPS battery, which shall support the ISC for a 24-hour duration. The ISC shall be installed with enough memory to support up to 100,000 cardholders or 50,000 events in a minimum configuration and be expandable to up to 500,000 cardholders.

In the event of a failure, transactions are to be stored in an ISC First-In-First-Out (FIFO) buffer until the ISC comes back online, at which time all data is uploaded to the database server.

70. Mobile Apps

- a. The mobile app for Keep is available for iOS and Android devices. It can be downloaded from the app store for each device at no cost and uses the same login credentials used for the user's instance of Keep.
- b. Functionality. The capabilities with the mobile app are:
  - 1) View, add or modify card holders
  - 2) Control doors with same functionality as the web or Windows client
  - 3) Control Bosch IDS areas, such as arming or disarming
  - 4) View hardware within the instance:
    - a) Controllers
    - b) Downstream panels
    - c) Readers
    - d) Inputs
    - e) Outputs
    - f) Bosch Panels
    - g) Bosch Areas
    - h) Bosch Points
    - i) Bosch Outputs
  - 5) View Events
  - 6) Lockdown/reset doors
  - 7) Send mass notifications

71. SMS Server Resiliency

- a. The Cloud Hosted SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below:
  - 1) Hourly Transaction backups
  - 2) Daily full backups
  - 3) Elastic Block Storage
  - 4) Distributed Intelligence

b. Distributed Intelligence

In the event SMS communications is lost, Intelligent System Controllers shall provide complete control, operation and supervision of all monitoring and control points. The ISC shall be configured with a UPS battery, which shall support the ISC for a 24-hour duration. The ISC shall be installed with enough memory to support up to 100,000 cardholders or 50,000 events in a minimum configuration and be expandable to up to 500,000 cardholders. In the event of a failure, transactions are to be stored in an ISC First-In-First-Out (FIFO) buffer until the ISC comes back online, at which time all data is uploaded to the database server.

END OF SECTION 281300



## SECTION 282300 - VIDEO SURVEILLANCE SYSTEM

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Video management system including the following as applicable:
  - 1. Digital video recording management and network software.
  - 2. Network video recorders.
  - 3. Cameras: For VMS.
    - a. Dome cameras.
  - 4. Electronic access control management system.

#### 1.2 RELATED SECTIONS

- A. Section 26 00 00 - Electrical.

#### 1.3 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Certifications: CE, FCC Class A, IK7, IK10, IP66, ISO, NEMA4, ONVIF, PSIA, RoHS 2, UL, and cUL, NEMA 4.
- C. Institute of Electrical and Electronics Engineers (IEEE): IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70 2005 National Electrical Code.
  - 2. NFPA 72 National Fire Alarm Code.
  - 3. NFPA 80 Fire Doors and Windows, 2007 Edition.
  - 4. NFPA 101 Life Safety Code, 2009 Edition.
- E. International Organization for Standardization (ISO): ISO 7816 Smart Card Standard.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- 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. Installation methods.
- C. Shop Drawings: Schematic of system components with physical space requirements.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2-year experience installing similar products.

#### 1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handle materials to avoid damage.

#### 1.8 PROJECT 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 recommended limits.

#### 1.9 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

#### 1.10 WARRANTY

- A. Manufacturer's limited warranty with 3-year parts and labor warranty period except where noted 5 year (Valerus Elite line of servers and IP cameras).

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Vicon Industries, which is located at: 135 Fell Court; Hauppauge, NY 11788; Toll Free Tel: 800-645-9116; Tel: 631-952-2288; Fax: 631-951-2288; Email: request info (AEC\_Support@vicon-security.com); Web: <http://www.vicon-security.com>
- B. For assistance responding to this bid, please contact Bob Kriegisch, Regional Sales Manager, Vicon Industries: C:302-554-0842, E: bobk@vicon-security.com

- C. Bidders are encouraged to bid the basis of design which is Vicon. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. Video surveillance and access control systems MUST be by the same manufacturer in order to guarantee complete systems integration and single pane of glass end user experience.

## 2.2 VIDEO MANAGEMENT SYSTEMS

### A. General:

- 1. All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.
- 2. All systems and components shall have been thoroughly tested and proven in actual use.
- 3. All systems and components shall be provided with the availability of a toll free 24-hour immediate technical assistance for the dealer/installer at no charge.
- 4. All systems and components shall be provided with an explicit manufacturer warranty.

### B. Valerus Shadow Elite Server System as manufactured by Vicon Industries.

- 1. Digital Servers: Powered by Dell and Intel technology. Warranty: 5 years.
  - a. Application servers, client workstations, recording servers (NVRs) and RAID recording servers.
  - b. A variety of available form factors depending on server type required.
    - 1) Micro small desktop.
    - 2) Small form factor desktop.
    - 3) Racks: 1U/2U/rack.
  - c. Next day on site support and 24/7 customer service.
  - d. Preloaded with Valerus Video Management System for quick installation, setup, and performance.
  - e. Available with a variety of processors, including Intel Core i7 and Xeon.
  - f. USB ports and monitor outputs. Some units provide iDRAC connectors.
  - g. Number of Cameras Supported, Storage Capacity and Max. Data Rate:
    - 1) Dependent on model selected. Models are available to support 250 cameras, 800 Mbps data rate and 520 TB storage.

- h. Housed in a rackmount or desktop type case, with suitable connectors available on the front or rear panel.
  - 1) Application Server: In 1U rack model.
  - 2) Client Workstation: In a micro or small form factor desktop or a 1U rack.
  - 3) NVRs: In a 1U rack or small form factor desktop model.
  - 4) RAID Recording Servers: In 1U, 2U, 2U (Deep) rack models and operated indoors.
  
- 2. Recording Servers: Internal hard-drive storage.
  - a. Small Form Factor: 8 Tb. Raw Storage, 7Tb Usable.
  - b. Recording Server to be programmed using the following parameters:
    - 1) 10 Frames per second per camera
    - 2) Continuous recording (no motion)
    - 3) Expected storage of 30 days Recording Servers:
  
- 3. NON-RAID Recording Servers:
  - a. *Model VERA-SF08N0-07D*, Small Form Factor.
  - b. Electrical Specifications:
    - 1) Certifications: FCC, Class A.
    - 2) Power Supply:
      - a) Small Form Factor: 200 W.
    - 3) Typical Power Consumption:
      - a) Small Form Factor: 100 W (350 BTU).
    - 4) Maximum Power Consumption:
      - a) Small Form Factor: 200 W (650 BTU).
    - 5) CPU:
      - a) Small Form Factor: Intel Core i7 10th Gen 16 GB DDR4.
    - 6) OS Drive: 256 GB M.2 NVMe SSD.

- 7) Data Drive Configuration: SATA.
  - 8) Display:
    - a) Small Form Factor: Intel HD 630. 2x DP; supports dual 4K monitor.
  - 9) Operating System: Microsoft Windows 10 Iot Enterprise.
  - 10) Networking:
    - a) Small Form Factor: 1x 1GbE RJ-45, Intel 82574 or Realtek.
  - 11) Front Panel Controls and Indicators:
    - a) Small Form Factor: USBs: 1x USB 3.2 C/1x USB 3.2/2x USB 2.0; Headphone.
  - 12) Rear Panel I/O and Controls:
    - a) Small Form Factor: AC power socket; USBs: 4x USB 3.2, 2x USB 2.0; 1x RJ-45, line in and line out; Display ports: 2x DP; Kensington lock.
- c. Mechanical Specifications:
- 1) Application: Indoor.
  - 2) Mounting:
    - a) Desktop: Small Form Factor (HxWxD): 11.42 x 3.65 x 11.53 inches (290 x 93 x 293 mm). Weight: 8.44 lb. (3.83 kg).
  - 3) Construction: Steel and plastic.
- d. Environmental Specifications:
- 1) Operating Temperature Range: 50 to 95 degrees F (10 to 35 degrees C).
  - 2) Operating Humidity Range:
    - a) Small Form Factor: 20 to 80 percent, non-condensing.
- e. Warranty: 5 years parts and labor.

## 2.3 CAMERAS FOR VIDEO MANAGEMENT SYSTEMS

### A. Dome Cameras:

1. Basis of Design: V2005D-W28IRM Outdoor IP Micro Dome Cameras as manufactured by Vicon Industries: Accessories to be included are: V2XXXD-PM Pendent Cap, SVFT-WM-1 Wall Mount and V2XXXD-ADPT Adapter
  - a. Certifications: CE, FCC Class A, IK10, IP66, UL, ONVIF S/G/M/T and NDAA/GSA/TAA compliant.
  - b. Equipment and Materials: Standard components regularly manufactured and used in the manufacturer's system.
  - c. Systems and Components: Thoroughly tested and proven in actual use.
    - 1) Provided with the availability of a toll free 24-hour technical support phone number from the manufacturer. This no charge service shall be available to dealers and installers.
    - 2) Provided with an explicit 5-year manufacturer warranty.
  - d. Features:
    - 1) Outdoor fixed dome camera shall incorporate a fixed camera/lens combination.
    - 2) True WDR and Smart or Adaptive IR capability.
    - 3) Intelligent Video Analysis, tampering, intelligent motion detection, intrusion detection, line cross, loitering, object left/removed, tailgating, and crowding. The 5 MP model shall also provide AI-based object classification analytics for vehicles, people and animals. This shall enhance working with Museum Search in Valerus VMS.
    - 4) Mounting: Surface mountable.
  - e. Camera Parameters:
    - 1) Imaging Device: 1/2.8-inch progressive scan.
    - 2) Maximum Resolution: 5 MP.
      - a) Sensitivity: Color: 0.03 lux; Black and White: 0.01 (IR OFF), 0 lux (IR On).
      - b) Horizontal Field of View: 104 degrees.
      - c) Vertical Field-of-View: 78 degrees.
      - d) Field-of-View Depth: 134 degrees.

- e) Resolution: 2592x1944/1520, 2560x1440, 2048x1536, 2304x1296, 1920x1080, 1600x1200, 1440x1080, 1600x900, 1280x960/720, 800x600, 640x480, 640x360, 320x240, 320x180.
- 3) Shutter Speed: 1/2 - 1/10,000 sec.
- 4) Automatic Gain Control: On/Off selectable.
- 5) Digital Zoom: Yes, ROI.
- 6) Lens Adjustment: Fixed.
- 7) Lens Focal Length: 2.8 mm.
- 8) IR Distance: Smart IR/Adaptive IR; 49 ft (15 m) with 8 IR LEDs.
- f. Physical Parameters:
  - 1) Operating Temperature: Minus 22 to 131 degrees F (Minus 30 to 55 degrees C).
  - 2) Operating Humidity: Up to 90 percent relative, non-condensing.
  - 3) Application: Indoor or Outdoor.
  - 4) Construction: Aluminum dome housing; polycarbonate clear dome. Dimensions: 2.2 in. (57 mm) x 4.3 in. (110 mm) diameter.
  - 5) Weight: 1.65 lbs (0.75 kg).
- g. Electrical Parameters:
  - 1) Input Voltage/Current: PoE, 0.28A.
  - 2) Power Consumption, IR on: 13.5 W.
  - 3) Connectors:
    - a) Pigtail cable.
    - b) PoE: RJ-45.
    - c) Video and Data: RJ-45.
    - d) Audio: Screw terminal, audio level alarm alert.
    - e) Slot for SD card.
    - f) Reset button.
    - g) Default button.

- 4) Radio Frequency Emission Rating: FCC Class A; CE.
- h. Network Parameters:
- 1) Communications: Open platform; compatible with Valerus Video Management System.
  - 2) Compression: Smart Encoding; H.264/H.265; M-JPEG.
  - 3) LAN Interface: 10 Base-T/100 Base-TX, Unicast/Multicast.
  - 4) Frame Rate: Up to 30 fps.
  - 5) Web Browser: Safari, Firefox, Google Chrome, Microsoft Edge.
  - 6) Users: Live viewing for up to 10 clients.
  - 7) Image Settings: Digital image effects defog, flip and mirror; configurable brightness, contrast, saturation, hue, sharpness; BLC; HLC; gamma correction; 3 DNR; motion detection; white balance, AGC; Electronic Shutter, automatic or manual; digital zoom; motion detection; privacy masks; motorized zoom and focus (lens); dynamic ROI.
  - 8) Intelligent Video Analytics: Tampering/Defocus, Intelligent Motion Detection, Intrusion Detection; Line Cross, Loitering, Object Left/Removed, Tailgating, Crowding. The 5 MP model shall also provide AI-based object classification analytics for vehicles, people, and animals. This shall enhance working with Museum Search in Valerus VMS.
  - 9) Supported Protocols: IPv4/IPv6, TCP, HTTP, HTTPS, RTSP, RTCP, RTP, RTMP, SMTP, SNMP v1/2c/3, UPnP, TLS/TTLS, FTP, HLS, ICMP, IGMP, LDAP, NTP, DHCP, DNS, DDNS, UDP, QoS, ARP, PPPoE, Bonjour, ONVIF S/G/M/T.
2. Basis of Design: V2005D-W313MIR Outdoor IP Dome Cameras as manufactured by Vicon Industries: Accessories to be included are: V2XXXD-PM Pendent Cap, SVFT-WM-1 Wall Mount
  3. :
    - a. Certifications: CE, FCC Class A, IK10, IP67, UL, RoHS, ONVIF S/G/M/T and NDAA/GSA/TAA compliant.
    - b. Equipment and Materials: Standard components regularly manufactured and used in the manufacturer's system.
    - c. Systems and Components: Thoroughly tested and proven in actual use.



- 1) Provided with the availability of a toll free 24-hour technical support phone number from the manufacturer. This no charge service shall be available to dealers and installers.
  - 2) Provided with an explicit 5-year manufacturer warranty.
- d. Features:
- 1) Outdoor fixed dome camera shall incorporate a fixed camera/lens combination.
  - 2) True WDR and Smart or Adaptive IR capability.
  - 3) Intelligent Video Analysis, tampering, intelligent motion detection, intrusion detection, line cross, loitering, object left/removed, tailgating, and crowding. The 5 MP and 8 MP models shall also have AI-based object classification analytics for vehicles, people, or animals. This shall enhance working with Museum Search in Valerus VMS.
  - 4) Mounting: Surface mountable.
- e. Camera Parameters:
- 1) Maximum Resolution: 5 MP.
    - a) Imaging Device: 1/2.8-inch progressive scan.
    - b) Sensitivity: Color: 3.1-10 mm: 0.03 lux; 8-18 mm: 0.02 lux. Black and White: 0.01 (IR OFF), 0 lux (IR On).
    - c) Horizontal Field of View: 3.1-10 mm: 96 to 32 degrees; 8-18 mm: 40 to 17 degrees.
    - d) Vertical Field-of-View: 3.1-10 mm: 69 to 24 degrees; 8-18 mm: 29 to 13 degrees.
    - e) Resolution: 2592x1944/1520, 2560x1440, 2048x1536, 2304x1296, 1920x1080, 1600x1200, 1440x1080, 1600x900, 1280x960/720, 800x600, 640x480, 640x360, 320x240, 320x180.
    - f) Lens Focal Length: 3.1 to 10 mm varifocal or 8-18 mm varifocal.
    - g) Current: PoE: 0.3 A; 24 VAC: 0.6 A; 12 VDC: 1.2 A.
    - h) Power Consumption IR and Heaters On: 14.4 W.
  - 2) Shutter Speed: 1/2 - 1/10,000 sec.
  - 3) Automatic Gain Control: On/Off selectable.

- 4) Digital Zoom: Yes, ROI.
  - 5) Tilt and Horizontal: Three-direction adjustment, allowing for adjustment of pan, tilt, and lens rotation.
  - 6) Lens Adjustment: Motorized lens, P-iris automatically adjusts to zoom condition.
  - 7) IR Distance: Smart IR/Adaptive IR; 131 ft (40 m) with 22 IR LEDs.
- f. Physical Parameters:
- 1) Operating Temperature: Minus 40 to 140 degrees F (Minus 40 to 60 degrees C).
  - 2) Operating Humidity: Up to 90 percent relative, non-condensing.
  - 3) Application: Indoor or Outdoor.
  - 4) Construction: Aluminum alloy body; polycarbonate clear dome. Dimensions: 4.49 in. (125 mm) x 5.3 in. (135 mm) diameter.
  - 5) Weight: 2.6 (1.2 kg).
- g. Electrical Parameters:
- 1) Input Voltage: 24 VAC plus 20 or minus 10 percent, 12 VDC plus or minus 10 percent or PoE.
  - 2) Connectors:
    - a) Two conduit access holes for internal cable termination.
    - b) Power: 12 VDC or 24 VAC terminal block.
    - c) PoE: RJ-45.
    - d) Video and Data: RJ-45.
    - e) Alarm: Screw terminal.
    - f) Audio: Screw terminal, audio level alarm alert.
    - g) Slot for SD card.
    - h) Composite output for installation-2-pin connector.
    - i) Reset button.
    - j) Default button.

- 3) Radio Frequency Emission Rating: FCC Class A; CE.
- h. Network Parameters:
- 1) Communications: Open platform; compatible with Valerus Video Management System.
  - 2) Compression: Smart Encoding; H.264/H.265; M-JPEG.
  - 3) LAN Interface: 10 Base-T/100 Base-TX, Unicast/Multicast.
  - 4) Video Channels: Triple streaming.
  - 5) Frame Rate: Up to 30 fps.
  - 6) Web Browser: Safari, Firefox, Google Chrome, Microsoft Edge.
  - 7) Users: Live viewing for up to 10 clients.
  - 8) Image Settings: Digital image effects defog, flip and mirror; configurable brightness, contrast, saturation, hue, sharpness; BLC; HLC; gamma correction; 3 DNR; motion detection; white balance, AGC; Electronic Shutter, automatic or manual; digital zoom; motion detection; privacy masks; motorized zoom and focus (lens); dynamic ROI.
  - 9) Intelligent Video Analytics: Tampering/Defocus, Intelligent Motion Detection, Intrusion Detection; Line Cross, Loitering, Object Left/Removed, Tailgating, Crowding. The 5 MP and 8 MP shall have AI-based object classification analytics for vehicles, people, or animals. This shall enhance working with Museum Search in Valerus VMS.
  - 10) Supported Protocols: IPv4/IPv6, TCP, HTTP, HTTPS, RTSP, RTCP, RTP, RTMP, SMTP, SNMP v1/2c/3, UPnP, TLS/TTLs, FTP, HLS, ICMP, IGMP, LDAP, NTP, DHCP, DNS, DDNS, UDP, QoS, ARP, PPPoE, Bonjour, ONVIF S/G/M/T.

## 2.4 ELECTRONIC ACCESS CONTROL MANAGEMENT SYSTEM

- A. Basis or Design: VEVA-MC00N0-00 VAX Server and VAX-SW40-3 Electronic Access Control Management Software as manufactured by Vicon Industries.
- B. System Description:
  1. Design Requirements: Shall provide products and systems that have been manufactured, fabricated, and installed to the following criteria: Comply with IEEE 1100, NFPA 70, NFPA 72, NFPA 80, NFPA 101.
  2. System Capabilities:

- a. Fully distributed processing, field devices are not dependent on server operations once programmed.
  - b. Control access to unlimited doors.
  - c. Control elevator access up to 64 floors per Cab.
  - d. Manage and control access for up to 100,000 credentials per controller.
  - e. Unlimited remote sites.
  - f. Configurable alert screen and email notifications.
  - g. Photo ID badging integration via SQL database
  - h. Readers, inputs, and outputs expandable and/or modifiable.
  - i. Single software program controlled.
  - j. 50 Programmable Holidays per Holiday Group.
  - k. 50 Holiday Groups configurable.
  - l. Multi-site Management via Partitions.
  - m. No client software needed, client accesses via HTML5 browser.
  - n. Anti-passback capability.
  - o. Full integration and customization of all system components.
  - p. Online reconfiguration through system programming without hardware changes.
3. Access Control Functions:
- a. Validation of Credential based on Time of day, Day of week, Holiday scheduling, mode of Door, and ad-hock schedule.
  - b. Simultaneous controlled access with various reader technologies; Proximity, PIN number, Biometrics, Mag stripe, Barcode.
  - c. Automatic or manual retrieval of cardholder photographs.
  - d. First person in capability.
  - e. Access validation based on positive verification of Credential, PIN, or Credential/PIN combination, or dual credential with one credential being a supervisor credential.

- f. Differentiates between valid credential presentation only, and valid credential presentation followed by entry (when using door position switch).
4. Passwords:
- a. Assignable.
  - b. Unlimited number of system Administrators.
  - c. Permissions of system Administrators are definable per Administrator.
  - d. Administrator actions/capabilities range from basic system monitoring to control of all system functions.
  - e. Administrators can be linked and managed by LDAP systems.
5. System Programming:
- a. User-friendly, intuitive, and responsive HTML5 web client interface.
  - b. Single Page Application (SPA) architecture allows seamless browser transition between pages.
6. Alert Messages:
- a. Ability to monitor for specific events and make them spawn additional windows or email the event to the administrator.
  - b. Alert information displayed in text format on the notifications area and highlighted based on severity of alert.
  - c. Video feed switching capabilities associated with alert via IP communication. (fully configurable).
  - d. Capability of E-Mailing alert events to administrators.
7. System integration:
- a. VMS integration: Vicon Valerus, ViconNet Digital Video Management system, Digital Watchdog DW Spectrum, exacq exacqVision, and Milestone Xprotect.
  - b. Microsoft Active Directory Integration via LDAP protocol.
  - c. CardPresso Photo badging software integration.
  - d. Alarm system integration via configurable dry contact output/input.
  - e. ASSA ABLOY Aperio hub integration.
  - f. Visitor Management:

- 1) HID Easylobby SVM.
  - g. Integration to other systems possible via HTTP API.
- C. System Minimum Requirements:
1. Central Processing Unit Computer: Microsoft compatible Windows 7 or newer. 2 GHz or faster 32-bit (x86) or 64-bit (x64) processor. Two or more cores. 4 GB RAM for 32-bit and 6 GB RAM for 64-bit. DVI or HDMI monitor. 5 GB hard drive space required (Additional space required for database). Microsoft .Net Framework 4.5 Full. Microsoft SQL Server 2008 or SQL Server 2008 Express or higher.
- D. Basis or Design: One Door Controller: VAX-1D-REX-1 as manufactured by Vicon Industries. (Two Required, one above each door requiring access control)
1. Supports 2 readers (IN and OUT configuration).
  2. Power input: IEEE 802.3af PoE standard provides up to 20 Watts.
  3. Processor: 32-bit microprocessor-based.
  4. Storage: 100,000 users, 50,000 events (onboard).
  5. Terminals: Quick disconnect terminal headers.
  6. Reader Communications: Wiegand Data1/Data0.
  7. Lock Power: Solid State 12 VDC at 500 mA / 24 VDC at 250 mA (with opt. converter).
  8. Auxiliary Power: 12 VDC at 200 mA max. (Used to power motion devices, Piezo's, etc.).
  9. Reader Power: 12 VDC at 450 mA max. per port.
  10. Relay Outputs: 2X solid state relay 60 V (TVS circuit limits 24 V), 1A, fully configurable, no mechanical ports.
  11. Relay Output Devices: Fully configurable to work with the following devices:
    - a. Door strike.
    - b. Magnetic lock (use external relay or dry contact module).
    - c. Door opener.
    - d. External buzzer.
    - e. External alarm systems (arming/disarming).
    - f. Gates.

- g. Auxiliary devices that will accept dry contact input.
      - h. Man trap devices (door open or unlocked).
- 12. Reader Formats: Magnetic stripe, Biometric, Bar code, and Wiegand up to 64 bit.
- 13. Inputs: 4 Dry contact inputs, fully configurable including supervised or digital input setting.
- 14. Input Functions Include:
  - a. Request to exit.
  - b. Door contact.
  - c. Door opener to enter (require card).
  - d. Door opener to exit.
  - e. External motion sensor.
  - f. Emergency alarm.
  - g. External alarm status (check if alarm system is armed).
  - h. Door prevent unlock (used with mantraps).
  - i. Auxiliary Input:
    - 1) Pulse selected output.
    - 2) Activate selected output.
    - 3) Deactivate selected output.
    - 4) Toggle selected output.
    - 5) Activate alarm interfaced.
    - 6) Disengage emergency alarm.
    - 7) Override doors with crisis levels.
- 15. Security: Hardware secured by configurable password.
- 16. Tamper Sensor: Photo tamper sensor (configurable) (no moving parts).
- 17. LED Indicator: 2 PoE power indicator, 2 Reader active indicators, 3 output indicators, 1 communication status and Door status and heartbeat LED beneath unit.

18. 2 Line x 16 Ch LCD Display (contrast adjustable) with LED back light (brightness adjustable) used for on-board diagnostics and initial configuration such as IP address and communication modes.
  19. Diagnostics: on-board diagnostics shall include Reader test, output test, input test, ping with IP, ping with name, Debug mode, read only mode.
  20. Keyboard: Four user push buttons for data entry or output selection.
  21. Sound: On-board piezo buzzer (90 dB at 100 mm).
  22. Time: Keeps up to 1 month without power connection, no battery needed. Automatic DST switch.
  23. Operating Temperature: 32 to 122 degrees F (0 to 50 degrees C).
  24. Operating Humidity: 10 to 90 percent relative humidity, non-condensing.
  25. Expandable modular design.
  26. PCB Dimensions: 2.91 x 7.72 in (74 x 196 mm).
  27. Enclosure Dimensions (W x H x D): 10.2 x 3.4 x 2.3 in (286 x 875 x 59.3 mm).
  28. Enclosure Color: Black or White.
  29. Compliance: Panel is ETL Listed conforms to UL 294 Certified to CSA-C22.2 no.205.
- E. Basis of Design: Proximity Single Gangbox Access Reader as manufactured by Vicon Industries: VAX-500R.
1. Dimensions: 3 x 4.6 x 0.4 inches (76x117x10 mm).
  2. Design: Weatherproof IP67.
  3. Characteristics: High reliability; consistent read range characteristics; low power consumption.
  4. Colors: Black; white snap-on cover included.
  5. LEDs: Four-state standard: Red, Green, Amber, and Off.
  6. Audio: Beeper included standard.
  7. Mounting: Single gangbox and flat surfaces; may be mounted directly to metal.
  8. Communication format: Wiegand ABA Track II.
  9. Frequency: 125 KHz excitation.



10. Read Range: up to 8 inch (202 mm).
  11. Operating Temperature: Minus 40 degrees F to 149 degrees F (Minus 40 degrees C to 65 degrees C).
  12. Current Draw: 35mA typical; 75 mA peak at 12 VDC.
  13. Compliance: FCC, ICC, CE, C-Tick, CSA, UL, ETL listed.
- F. Basis of Design: Proximity Key Tag as manufactured by Vicon Industries: VAX-PRX-TAG.
1. Dimensions: 1.5 x 1.2 x 0.15 inches (36 x 30 x 3.8 mm).
  2. Frequency: 125 kHz excitation.
  3. Operation: Passive (no battery).
  4. Read Range: Up to 3.5 inches (88 mm).
  5. Material: ABS.
  6. Color: Light gray.
  7. Operating Temperature: Minus 35 to 122 degrees F (minus 37 to 50 degrees C).
  8. Slot Punch: Reinforced Brass eyelet easily fits on key ring.
  9. Communication format: Wiegand 26 bit and ABA Track II magnetic stripe.
  10. Compliance: FCC, CE, ETL.
- G. Software Features and Functions:
1. Server Software:
    - a. Shall be installed on a standard PC running Microsoft Windows 10 or Higher or Windows Server 2016.
    - b. 2 GHz or faster 32-bit (x86) or 64-bit (x64) processor. Two or more cores.
    - c. 4 GB RAM for 32-bit and 4 GB RAM for 64-bit.
    - d. DVI or HDMI monitor.
    - e. 10 GB hard drive space required (additional space required for database).
    - f. Microsoft .Net Framework 4.81 Full.
    - g. Shall support Microsoft SQL Server 2016, SQL Server 2016 Express, or later version.

- h. Shall be 100 percent web based and can be accessed via any web enabled device including Cell Phones, Tablets, Laptops, PCs with any operating system etc. without the need for any additional plug-in's (i.e. no active x controls, Flash, etc.).
  - 1) Google Chrome (desktop and mobile).
  - 2) Mozilla Firefox.
  - 3) Apple Safari (desktop and mobile)
  - 4) Other browsers that support HTML5 may function but are untested.
- i. Web interface and controller communications shall be possible through WAN/LAN if network allows.
- j. Software design shall be of a Single Page Application (SPA) architecture allowing seamless navigation between screens.
- k. Shall have Responsive Web interface. Interface will automatically adjust to ensure an optimal experience based on device.
- l. Shall have ability to Partition software for multisite all hosted from one location allowing site administrators only access to their site readers and cards or multiple sites.
- m. Shall have functions that will be accessed via tool bar Icons, including Help prompts that will appear when the mouse pointer hovers over the selection button.
- n. Shall be possible to install the server software in a virtualized environment.
- o. Communication shall use SSL encryption with modern cryptography, utilizing TLS 1.2, and AES 256 GCM/DHE RSA as the key exchange mechanism.
- p. Software shall advise when a software update is available and who to contact to upgrade.
- q. Software shall utilize a smart installer, capable of the following functions:
  - 1) Analyze if installation prerequisites are met.
  - 2) If prerequisites are missing, installer will locate them on installation media or download from the internet.
  - 3) Automatically create SQL instance and database.
  - 4) Automatically assign database permissions and setup service users.

- 5) Automatically add Windows Firewall exceptions for communication ports.
  - 6) Web server, controller communication and management interface can be configured on alternate ports.
  - 7) Installer can upgrade the software.
  - 8) Ability to configure different communication ports when installing the software.
  - 9) Ability to configure web services to run as a different windows user.
  - r. Software shall have the capability to be run via command line for advanced troubleshooting.
  - s. Web interface shall utilize Gzip compression for reduced load times and bandwidth consumption.
  - t. Web interface shall utilize cache control for static files such as images, static text, and cardholder images.
  - u. Software shall provide a unified interface for doors and elevators, including shared time schedules and access groups.
  - v. User interface (UI): Can be changed from English to Spanish or French.
2. Administrator Control Capabilities:
- a. Shall provide an Administrator interface secured by encrypted password control and SSL communication from web client to server.
  - b. System shall support unlimited administrator accounts.
  - c. Shall provide for an Administrator that can either be a System-Admin or a Non-sys-admin with customizable permissions. Permissions can be granted globally or for a specific partition/actor to an Administrator or Security Group.
  - d. Ability to reset administrator passwords via email.
  - e. Administrator actions and changes shall be logged and visible to other administrators via reporting tools.
  - f. Shall support Administrator Management which determines privileges, functions, and Partitions that can be accessed. Functions that cannot be accessed will not be visible. The following items are available:
    - 1) Manage Access Privilege Groups.
    - 2) Manage Cameras and Integration.

- 3) Manage Door Holiday Groups.
- 4) Manage Door Holiday Schedules.
- 5) Manage Door Schedules.
- 6) Manage Doors.
- 7) Manage Elevators.
- 8) Manage Floor Holiday Groups.
- 9) Manage Floor Holiday Schedules.
- 10) Manage Floor Schedules.
- 11) Manage Holidays.
- 12) Manage OneTimeRun Schedules.
- 13) Manage Panels.
- 14) Manage Sites.
- 15) Manage User Holiday Groups.
- 16) Manage User Holiday Schedules.
- 17) Manage User Schedules.
- 18) Manage Users.
- 19) Reporting Alerts.
- 20) Reporting DoorActivity.
- 21) Reporting FloorActivity.
- 22) Reporting UserActivity.
- 23) Reporting UserList.
- 24) Special Permissions Override Door.
- 25) Override Floor.
- 26) Override Output.
- 27) Update Panel.
- 28) View Cameras.

- 29) View Status.
  - g. System shall render functions that administrators do not have access to invisible and inaccessible.
  - h. Ability for administrators to configure personal settings the following functions:
    - 1) Customize which notifications are visible when viewing event monitoring.
    - 2) Choose which events should be treated as alerts.
    - 3) Choose which events will prompt an email being sent to the administrator.
    - 4) Choose if alerts will activate a sound in the web browser.
    - 5) Choose which notifications will spawn in-line camera view of associated devices.
    - 6) Customize notifications by groups/types and viewed by specific users, schedules, etc.
  - i. Ability to integrate administrator authentication with LDAP systems.
3. VAX Database Segregation and Multi-Tenant Hosting Management Capabilities:
- a. System shall support the ability to host multiple VAX systems on a single software installation.
  - b. Each tenant shall have their own individual database.
  - c. System shall allow the following configuration when multi-tenant mode is enabled:
    - 1) Ability to add new tenant.
    - 2) Ability to configure the database connection string for each tenant.
    - 3) Ability to define one or more DNS subdomains for each tenant which shall be used to access the tenants VAX database.
    - 4) Ability to define which hardware controllers are associated to each tenant (MAC address).
    - 5) Ability to define individual backup settings and backup schedules for each tenant.

- d. System shall support the ability to import an SSL certificate (including WildCard Certificates) with either the of the following file extensions:
  - 1) \*.CER.
  - 2) \*.PFX.
- 4. Site Management:
  - a. Labeling:
    - 1) Ability to name any created sites.
    - 2) Ability to create a description for each site.
    - 3) Ability to assign a Site to a Partition.
    - 4) Ability to designate a timezone that the site will reside in, used to automatically convert devices timezone to local time zone.
  - b. Areas:
    - 1) Ability to configure up to 254 areas in each site.
    - 2) Ability to apply a name to each area.
    - 3) Ability to assign to a reader what area the reader grants access to.
    - 4) Ability to run muster report based on site and areas.
  - c. Anti-passback Configuration to allow:
    - 1) Local Timed anti-passback: Ability to control re-entry into an area, at a specific door, based on a definable time value.
    - 2) Reset: Allow the ability to reset the anti-passback on a per panel basis.
    - 3) Ability to configure soft or hard anti-passback.
    - 4) Ability to configure anti-passback to ignore cardholders with the Supervisor flag.
    - 5) Ability to configure anti-passback to ignore or take into consideration the opening of a door as a cardholder entering/exiting an area.
- 5. VAX Historical Reports:
  - a. Ability to execute various historical reports in the system and define which administrators can run which reports.

- b. Ability to define a Start Time and Stop time for each report using intuitive slider bars or manually input time.
- c. Ability to select a time zone (EST, UTC, etc) that the results of the report will be displayed in.
- d. Ability to export any report into CSV or HTML format file for later viewing.
- e. Ability to email reports automatically using script engine (ACE).
- f. Historical information related to an elevator or door shall have a camera icon associated with the event that when clicked will bring up historical video for any cameras associated with that door/elevator at the specific time of the event if there are cameras associated with the device the event is related to.
- g. Ability to execute the following historical reports:
  - 1) Administrator Log Report:
    - a) Ability to select one, some or all administrators to run the report against.
    - b) View administrator activity for the selected administrators, including changes to users, system settings, panel updates, the time of the change along with the previous value of the field in some cases.
    - c) Logged administrator changes shall include the new value of the change, and the old value of the change.
  - 2) User Activity Report:
    - a) Ability to select one, some or all users/cardholders to run the report against.
    - b) View user activity for the selected users based on date criteria. Results will include all doors/floors the user has been granted/denied access to, along with which credential that was used.
  - 3) Door Activity Report:
    - a) Ability to select one, some or all doors to run the report against.
    - b) View door/reader activity for the selected doors based on date criteria, including the time of the event, the device that spawned the event, a user/credential if the event involved a user and the message associated with the event.

- 4) Floor Activity Report:
  - a) Ability to select one, some or all elevator floors to run the report against.
  - b) View Floor activity for the selected floors based on date criteria, including the time of the event, the device that spawned the event, the Cab the floor is attached to, a user/credential if the event involved a user and the message associated with the event.
- 5) Input Activity Report:
  - a) Ability to select one or more Inputs attached to any IO-Panels or Door Panels in the system that was defined as an "Aux Input."
  - b) View Input activity for the selected Inputs based on date criteria, including the time of the event, the device that spawned the event, the controller the Input is attached to and the message associated with the event.
- 6) Output Activity Report:
  - a) Ability to select one or more Outputs attached to any IO-Panels or Door Panels in the system that was defined as an "Aux Output."
  - b) View Output activity for the selected Outputs based on date criteria, including the time of the event, the device that spawned the event, the controller the Output is attached to and the message associated with the event.
- 7) Muster Report:
  - a) Ability to select a site and areas to run the report against.
  - b) View cardholders that are in the selected areas based on the date criteria.
- 8) Notifications Report:
  - a) Ability to view all historical notifications/events based on date criteria.
- 9) User List Report:
  - a) Ability to generate a list of all cardholders in the system along with their user properties, credentials, and which access groups they are a member of.
- 10) Alert Monitoring Report:



- a) Ability to have a separate screen dedicated to monitoring live notifications.
- b) Ability to use global or temporary notification filtering options.
- c) Ability to track which notifications the administrator has seen or missed.
- d) Ability to auto select notifications as they come in.
- e) Ability to click on a notification and see more information about that specific notification. If a cardholder is attached to the event and has a picture; Picture will display as large as possible on the same screen.

11) Time Tracking Report:

- a) Ability to select one or more Entry Readers to run the report against.
- b) Ability to select one or more Exit Readers to run the report against.
- c) Ability to export an HTML or CSV output.
- d) Report shall display the following:
  - 1) List of cardholders who have gone through any of the selected Entry or Exit readers.
  - 2) Entry and exit time each day (can have multiple entries and exits each day).
  - 3) Time between entry and exit.
  - 4) Display time of 0 if there was an exit without an entry or an entry without an exit on the same day.
  - 5) Total time between entry and exit between all days defined in the report parameters.
  - 6) Total time between entry and exit for all cardholders added together between all days defined in the report.

h. Ability to execute the following configuration reports:

- 1) Access Privilege Group Configuration.
- 2) Door Configuration.

- 3) Elevator/Floor Configuration.
  - 4) Input Configuration.
  - 5) Output Configuration.
  - 6) Panel Network Configuration.
  - 7) Schedule Configuration.
6. VAX Notification and Alert Management:
- a. Software web interface shall provide an in-line notification area that statically follows the screen as the administrator navigates the software.
  - b. Notification area shall provide near real-time events as they are happening.
  - c. Ability to click on specific notifications and be linked to a page in the web interface specific to the event such as:
    - 1) Clicking an "unknown connection from panel with MAC address 4A5342343" will bring the administrator to the "Add panel" screen with the Mac address filled.
    - 2) Clicking an "Unknown user denied access with credential 33-45545" will bring the administrator to the "Add User" screen with the credential pre-populated.
    - 3) Clicking an "Access Denied" or "Access Granted" notification will bring the administrator to the "Edit User" page of the specific user.
  - d. Ability to configure which notifications show up in red (alerts).
  - e. Ability to configure if alerts will produce a warning sound in the web browser.
  - f. Ability to configure which notifications/alerts will be emailed to the administrator.
  - g. Ability to pause real time events.
  - h. Ability to clear real time events that are currently on the screen.
  - i. Ability to configure which notifications spawn in-line camera view with associated cameras.
  - j. Ability to configure which notifications will send an email with information about the event to the administrator.
  - k. Notification Rule Engine: For the customization (color/sound) of all notifications.

1. Web Push: Allows the selection of specific notifications to be pushed to the desktop system.
7. Open Supervised Device Protocol (OSDP): Supported for improved cybersecurity.
  - a. Enhances security with peripheral devices such as card readers.
  - b. Supports 2-way encrypted communication via AES-128 allowing detection of disconnected readers.
  - c. Supports VAX-MDK and VAX-TROVE controllers with specific firmware.
  - d. Supports several VAX readers.
8. VAX Custom Script Engine (ACE):
  - a. System shall support customizable script engine that can be described as:
    - 1) Action Control Engine.
    - 2) Server Side Script Engine.
    - 3) Global Linking.
    - 4) Rules Engine.
    - 5) Action scheduler .
  - b. Script engine shall consist of a script (Action Plan) and a definable trigger (Action Trigger) to execute the script.
  - c. Script (Action Plan) shall consist of one or more Actions chained together to accomplish a task.
  - d. Action Plans shall be executed via web browser button, HTTP API command or from a definable Action Trigger.
  - e. Action Plans shall have the following capabilities:
    - 1) Action Plan shall be assigned a unique name.
    - 2) Action Plan shall utilize easy to use drag and drop interface for creating a graphical easy to read script.
    - 3) Action Plan shall support unlimited combinations of Actions.
    - 4) Support over 40 different actions which can be chained together.
    - 5) Actions shall support conditional chain to allow a different set of Actions to occur if the previous Action in the chain succeeds or fails.

- 6) Action Plans shall support customizable variables that can be pre-set or utilize variables from the trigger such as User Id, Door Id, Card number.
- 7) Action Plans shall be capable of supporting arithmetic operations and comparisons between variables.
- 8) Support communication with other systems with the following Actions:
  - a) HTTP Request Action.
  - b) SMS Send Action.
  - c) Email Send Action.
  - d) Notify Administrator.
- f. Action Triggers shall have the following capabilities:
  - 1) Define which Partition the trigger is scoped to.
  - 2) Define if the trigger conditions are restricted to a specific sit.
  - 3) Define the type of trigger condition and trigger state.
  - 4) Define if the trigger condition can be met by a specific object or any object within the trigger type and state.
  - 5) Define time restrictions to limit what day of week and time of day the trigger conditions can be met.
  - 6) Define a time drift to allow trigger conditions to be met if the source of the trigger comes later than real time.
  - 7) Define which Action Plan will execute when the trigger conditions are met.
  - 8) Define how much logging the Action Plan will perform.
9. VAX Interactive Map Management:
  - a. System shall support the ability to display and customize an interactive map.
  - b. System shall allow configuration of unlimited maps.
  - c. Floor plans shall be imported as .JPG, .BMP, .PNG or .GIF file which are commonly exported from CAD programs.
  - d. Configuration of a map shall include the following functionality:
    - 1) Ability to name each map.

- 2) Ability to select a picture to import as the map.
  - 3) Ability to associate a map to a Partition and a Site.
  - 4) Ability to configure relationships between maps for navigational purposes (North, South, East, West, Up, Down).
  - 5) System shall utilize click and drag mechanics to easily place objects onto the map.
  - 6) Ability to place any of the following objects onto a map:
    - a) Doors.
    - b) Elevator Floors.
    - c) Inputs.
    - d) Outputs.
    - e) Areas.
    - f) Cameras
  - 7) Ability to draw an area on the map for the purpose of monitoring occupancy levels of an area.
- e. Monitoring a map shall include the following functionality:
- 1) Icons shall dynamically change based the following circumstances:
    - a) Door objects will change color based on schedule type (Card mode, PIN, Unlocked, etc.).
    - b) Door objects icon will change between a closed and open icon based on door contact state.
    - c) Input and Output icons shall change color based on schedule type.
    - d) Input icons shall change based on input state (open or closed).
    - e) Elevator Floor icons shall change color based on schedule type.
    - f) Real-time indication of a door's state (locked/unlocked).
  - 2) Ability to navigate between maps via named tabs on the top of the screen.
  - 3) Ability to navigate between maps that are related to each other (North, South, East, West, Up, Down).

- 4) Contextual sidebar area will display information about the currently selected object:
    - a) Live camera view shall appear in the contextual sidebar if a selected object is a camera or has an associated camera.
    - b) Door schedule and status information shall appear in the contextual sidebar when a door is selected.
    - c) Names of cardholders estimated to be in an area shall appear in the contextual sidebar when an area is selected.
    - d) Ability to override schedules and outputs on selected object from contextual sidebar.
  - 5) Lock State: Shows the real time status of the door strike output.
10. VAX Triple Swipe Actions:
- a. Ability to configure a reader and credential to activate one or more functions via swiping or presenting a credential 3 times in a row within a set span of time.
  - b. Ability to configure a single triple swipe action per reader if using regular proximity type reader.
  - c. Ability to configure which users/cardholders can execute triple swipe actions, including which users can disarm the alarm system.
  - d. Ability to configure up to 5 triple swipe actions at one reader if the reader has keypad input.
  - e. Ability to use any of 3 predefined triple swipe actions when using keypad input for a total of 8 actions.
    - 1) Override the door into card mode.
    - 2) Resume an overridden door.
    - 3) Resume any overridden outputs.
  - f. Ability to change the mode of a door via triple swipe action:
    - 1) Override Lockdown Mode.
    - 2) Override Card mode.
    - 3) Override PIN mode.
    - 4) Override Card or PIN mode.

- 5) Override Card and PIN mode.
  - 6) Override Unlock mode.
  - 7) Override First Card In mode.
  - 8) Override Toggle Lockdown Mode.
  - 9) Override Toggle Card mode.
  - 10) Override Toggle PIN mode.
  - 11) Override Toggle Card or PIN mode.
  - 12) Override Toggle Card and PIN mode.
  - 13) Override Toggle Unlock mode.
  - 14) Override Toggle First Card In mode.
  - 15) Override Lockdown with Auto-resume.
  - 16) Override Card mode with Auto-resume.
  - 17) Override PIN mode with Auto-resume.
  - 18) Override Card or PIN mode with Auto-resume.
  - 19) Override Card and PIN mode with Auto-resume.
  - 20) Override Unlock mode with Auto-resume.
  - 21) Override First Card In mode with Auto-resume.
  - 22) Cancel Override.
- g. Ability to toggle, activate, deactivate, or pulse a relay via triple swipe action.
  - h. Ability to toggle, activate, deactivate, or pulse an output connected to an external alarm system to arm or disarm an alarm.
11. VAX Crisis Levels (Emergency Lockdown):
- a. Ability to configure up to 16 Crisis levels (Code Red, Code yellow, Code Green, etc.) that can be used to quickly make global changes to the entire system in an emergency.
  - b. Ability to configure the name and door mode of each crisis level.
  - c. Ability to apply a crisis level to all doors in a particular site or a single door via web browser interface.

- d. Ability to apply a crisis level to a panel via an Aux input function.
  - e. Ability to apply a security level to each user/cardholder. If a user/cardholder security level is equal or higher than the crisis level, the user/cardholder will be granted access based on the door mode and access privilege rules.
12. VAX Video Camera integration:
- a. Ability to integrate with 1 or more of the following Video Management Software (VMS) systems:
    - 1) ViconNet Digital Video Management system.
    - 2) Vicon Valerus.
    - 3) Digital Watchdog DW Spectrum.
    - 4) ExactQ ExactVision.
    - 5) Milestones Xprotect.
  - b. Support to integrate with multiple instances of VMS systems across different communication mediums such as LAN/WAN.
  - c. Ability to synchronize individual cameras or groups of cameras from the VMS software.
  - d. Shall support real-time video monitoring displays:
    - 1) Up to 2 separate video streams simultaneously.
    - 2) View up to 16 cameras in each stream (if VMS supports matrix larger than 1 x 1).
    - 3) View in-line camera view, browser view or full window view.
  - e. Associate cameras with a door, elevator, or both.
  - f. Associate a PTZ camera with a door based on a pre-set position.
  - g. Ability to configure specific events to spawn an inline camera view directly above the notifications/events area of the web interface.
  - h. Linking of video and events based on pre-set events provided by the access control software.
  - i. Historical events can spawn a video matrix to cameras based on the time of the event and associated cameras.



- j. Administrator permissions specific to who can manage and make changes to the camera system.
13. VAX Visitor Management Integration:
- a. Ability to allow integration into VAX through the API from HID EasyLobby.
    - 1) EasyLobby 10.2.0 and requires integration module from HID (EL-ACI-VICON).
  - b. Visitor checked in are automatically enrolled into VAX with:
    - 1) First name, last name, expire date, start date, photo, credential, unique identifier, privileges.
  - c. Visitor checkouts automatically revoke permissions or delete the record in VAX (configurable).
14. Automatically assign permissions across multiple partitions using assigned Access Group suffix.
15. Badge Design and Printing shall provide the following:
- a. Badge printing shall provide the ability to print various designs on printable card credentials.
  - b. Card templates shall be provided, with the ability to design front and back of cards.
  - c. Cards shall be able to be printed to any card printers on the network.
  - d. Ability to link card to database data and include links to any of the customizable card holder fields, including date of birth, titles, initials, first or last name and photography.
  - e. Ability to import Cardholder photographs or images from files.
16. Schlage Integration:
- a. Allegion Schlage wireless locksets shall integrate with VAX through a server and the ENGAGE Gateway. It shall be able to view status of alarm partitions and alarm zones, arm and disarm, bypass zones, contact emergency services and silence trouble beeping.
  - b. Three external components to integrate Schlage Locksets: ENGAGE Gateway acts as a Panel; Schlage Lockset acts as a Door and the Allegion ENGAGE to register app and devices to a Schlage system.
17. Administrator Control Capabilities:

- a. Shall provide an Administrator interface secured by encrypted password control and SSL communication from web client to server.
- b. Shall provide for an Administrator that can either be a System-Admin or a Non-sys-admin with customizable permissions.
- c. Shall support Administrator Management which determines privileges, functions, and Partitions that can be accessed. Functions that cannot be accessed will not be visible. The following items are available: Manage Access Privilege Groups, Manage Cameras And Integration, Manage Door Holiday Groups, Manage Door Holiday Schedules, Manage Door Schedules, Manage Doors, Manage Elevators, Manage Floor Holiday Groups, Manage Floor Holiday Schedules, Manage Floor Schedules, Manage Holidays, Manage OneTimeRun Schedules, Manage Panels, Manage Sites, Manage User Holiday Groups, Manage User Holiday Schedules, Manage User Schedules, Manage Users, Reporting Alerts, Reporting DoorActivity, Reporting FloorActivity, Reporting UserActivity, Reporting UserList, Special Permissions Override Door, Override Floor, Override Output, Update Panel, View Cameras, View Status.

18. System Partitioning:

- a. System shall support unlimited partitions (with appropriate licensing), which logically separate the system into pieces.
- b. Administrators can be given permissions to manage specific aspects of a partition or multiple partitions.
- c. Administrators shall only see partitions or parts of partitions they are explicitly given permission to manage.
- d. Ability to assign user/cardholders to more than 1 partition, if the Administrator assigning access groups has permissions to manage cardholders within the desired partitions.
- e. Administrators with limited permissions will not see the menus/icons for parts of the software they do not have permission to use.
- f. Door and Elevator Panels shall be assigned to a single partition.
- g. Holidays, schedules, and Access groups shall not be shared between partitions.
- h. Administrator shall not see events on devices they do not have permission to view/manage.
- i. Custom Fields and Crisis Levels settings shall be shared between partitions.

19. Credential/Cardholder Management:

- a. Shall provide User/Cardholder management screen with unlimited number of users/cardholders (100,000 per controller).
- b. Shall provide Simple cardholder enrollment, with all available cardholder options available on one screen.
- c. Shall support assignment of Unlimited credentials to a single cardholder, including Cards, Pins, biometrics, etc.
- d. Shall support assignment of additional user/cardholder attributes. Assign a Start/Stop date to a cardholder. Assign a security level for Crisis Level feature. Assign the cardholder as a Master user. Assign the cardholder as a supervisor user. Assign the cardholder the permission to activate First Person In schedules. Assign the cardholder the ability to perform Triple Swipe Actions. Assign the cardholder the ability to disarm an external alarm system. Assign the cardholder the ability to open auto-openers without the use of a button.
- e. Shall provide ability to view a list of all cardholders.
- f. Shall provide capability of finding a specific card holder based on specified search criteria such as name or credentials.
- g. Shall provide the ability to assign a photographic image for each cardholder, image can be uploaded from local device or taken in the web browser with an image device. (Chrome only).
- h. Shall provide ability to assign to Unlimited Access Privilege Groups.
- i. Shall provide ability to assign cardholder to Access Privilege Groups across different Partitions.
- j. Shall provide ability to assign cardholder directly to a partition for later access assignment.
- k. Shall provide ability to assign unlimited custom fields to a cardholder.
- l. Shall provide ability to import large amounts of users/cardholders via CSV file.
- m. Shall provide ability to assign cardholder to Access Privilege Groups across different Partitions.
- n. Shall provide ability to assign cardholder directly to a Partition for later access assignment.
- o. Shall provide ability to assign Unlimited custom fields to a cardholder.
- p. Shall provide ability to import large amounts of users/cardholders via CSV file.

- q. System shall optionally disallow creation of PIN numbers that are too similar to other PIN numbers automatically.
20. Access Privilege Groups:
- a. Shall support ability to create unlimited administrator definable/customizable Access Privilege Groups.
  - b. Shall support ability to apply any combination of door/time zone.
  - c. Shall support restriction/allowance of Cardholders movement through identified doors, at specific times, including holiday schedule.
  - d. Cardholders can be assigned to multiple access groups for enhanced customization.
  - e. Software shall have built in validation to prevent conflicts of users being given different permissions for the same doors/floors.
  - f. Ability to search for readers, floors and users when creating or modifying Access Privilege Groups.
21. Time Zone Management:
- a. The system shall have separate sections for time zones for user access (User Time Zones), door access (Door Times Zones), as well as floor access (Floor Time Zones).
  - b. The system time zones shall be drag and drop graphics allowing for easy viewing, as well as eliminating the chance of programming error.
  - c. The system time zones shall be color coded to the mode of the span for easy viewing and eliminating the chance of programming error.
  - d. Shall have ability to provide a specific schedule name and description.
  - e. Ability to re-use time schedules across multiple devices.
  - f. Ability to replicate a schedule across multiple days via click and drag to weekdays, weekends, week.
  - g. Software shall create per-configured time schedules used in typical deployments.
  - h. Door Time Zones (door schedule):
    - 1) Shall support an Unlimited amount of Door Time Zones.
    - 2) Shall support 20 unlock/lock times per day.

- 3) Shall support 8 different Time Zone modes in any combination:
  - a) Ability to have Lockdown (no cards other than cards flagged as master will be granted access).
  - b) Ability to have Card Only (valid cards required to grant access).
  - c) Ability to have PIN Only (valid PINs required to grant access).
  - d) Ability to have Card or PIN (valid card or PIN required for access).
  - e) Ability to have Card and PIN (valid card and PIN required for access).
  - f) Ability to have Unlock (door is in public mode).
  - g) Ability to have "First Credential in" by card (door will not follow its public schedule until a card flagged with first card in feature is presented at the door during the public schedule).
  - h) Ability to have Dual Credentials (2 valid cards one flagged as supervisor required to grant access).
- i. User Time Zone (user access schedule):
  - 1) Shall support up to 256 User Time Zone schedules the system will support.
  - 2) Shall support 8 Allowed/Not Allowed time spans per day.
  - 3) Shall support 2 different Time Zone modes in any combination:
    - a) Ability to have Allowed (user will be allowed through the door as long as the Door Time Zone is in a mode that accepts the type of credential being presented).
    - b) Ability to have Not Allowed (user will be denied access to the door).
- j. Floor Time Zones (elevator floor schedule):
  - 1) Ability shall support Unlimited Floor Time zone schedules the system will support.
  - 2) Ability shall have 8 time spans per day.
  - 3) Shall support 3 different Time Zone modes in any combination:
    - a) Ability to have Card Only (valid cards required to grant access).

- b) Ability to have Unlock (floor is in public mode).
    - c) Ability to have Lockdown (no cards other than cards flagged as master will be granted access).
  - k. Input Time Zones (Input schedule):
    - 1) Ability to support unlimited Input Time zone schedules the system will support.
    - 2) Ability to have up to 5 time spans per day.
    - 3) Support 2 different Time Zone modes in any combination:
      - a) Ability to have Monitor (Input will be monitored during this span).
      - b) Ability to have Not Monitored (Input changes will be ignored).
  - l. Output Time Zones (Output schedule):
    - 1) Ability to support unlimited Output Time zone schedules the system will support.
    - 2) Ability to have up to 11 time spans per day.
    - 3) Support 2 different Time Zone modes in any combination:
      - a) Ability to have ON (Output relay will close during this span).
      - b) Ability to have OFF (Output relay will open during this span).
  - m. One Time Run Time Zones (elevator and doors):
    - 1) Ability to create one time event schedules that can change the state and mode of a door or elevator floor for a period of time, can also span multiple days.

22. Holiday Management to Allow:

- a. Ability to apply a specific schedule for groups of doors to follow when it is a holiday.
- b. Ability to apply a specific user schedule for groups of users to follow during a holiday.
- c. Ability to create a holiday with the following options: Date of the holidays. If the holiday is reoccurring annually. Name and description of the holiday. Which groups of doors will be affected by the holiday and what holiday time zone they will follow. Which groups of Access Privilege Groups will be affected by the holiday and what holiday time zone they will follow. Which

groups of elevator floors will be affected by the holiday and what holiday time zone they will follow. Which groups of inputs and outputs will be affected by the holiday and what holiday time zone they will follow.

23. Door Management shall provide the following:
  - a. Ability to apply a specific name and description to each door and reader.
  - b. Ability to apply a time zone to control when a specific door is to unlock/lock, accept cards, pins, etc.
  - c. Ability to apply a Holiday group to control how a specific door will behave on a Holiday.
  - d. Configure Door Held Open:
    - 1) Ability to disable Door Held Open alert.
    - 2) Ability to disable Held Open buzzer.
    - 3) Ability to configure how long a door can be held open before an alert is raised.
    - 4) Ability to configure if the held open alert/buzzer will stop once the door is closed.
  - e. Configure Forced Open:
    - 1) Ability to disable Door Forced Open alert.
    - 2) Ability to disable Forced Open buzzer.
    - 3) Ability to configure if the Forced Open alert/buzzer will stop once the door is closed.
  - f. Ability to configure an unlock delay.
  - g. Ability to configure how long the door will be unlocked after a valid credential presentation.
  - h. Ability to configure the controller to play a sound when the door opens.
  - i. Automatic Door Operator Integration:
    - 1) Ability to enable/disable the use of an auto-opening device on a door.
    - 2) Ability to configure an unlock delay when using auto-opening device.
    - 3) Ability to configure the insecure side of the door to require a card read before auto-opener button will function.

- 4) Ability to configure auto-opener to open with REX.
  - 5) Ability to configure auto-opener to open with motion.
- j. Reader Configuration:
- 1) Ability to apply a name and description to a reader.
  - 2) Ability to enable/disable keypad use on a reader.
  - 3) Ability to configure how many seconds between PIN presses will pass before the credential becomes invalid.
  - 4) Ability to configure back to back reader interference interval.
  - 5) Ability to configure what area a reader is granting access to for use of tracking where users are in a building (used for muster and anti-passback).
  - 6) Ability to configure Triple Swipe actions.
- k. Local Anti-passback Configuration
- 1) Ability to enable local anti-passback.
  - 2) Ability to monitor door contact for passage through a door.
  - 3) Ability to configure soft or hard anti-passback.
  - 4) Ability to configure a timeout period for anti-passback.
  - 5) Ability to exclude supervisor users from anti-passback limitations.
- l. Camera Association Configuration:
- 1) Ability to create an association between a door and a camera(s).
  - 2) Ability to view associated cameras from the doors page.
  - 3) Ability to associate a predefined position to a camera if using PTZ camera.
- m. Door Schedule Override:
- 1) Ability to deviate the state of the door from the normal schedule.
  - 2) Ability to override a door until explicitly resuming the normal schedule.
  - 3) Ability to override the state of a door and instruct the controller to resume the normal schedule once the door is scheduled to change state. The door will resume normal schedule after that.



- 4) Ability to override a door for a specified period (5 minutes or more).
  - 5) Ability to resume a door to its normal schedule regardless of override method.
  - 6) Ability to override a door through the following method:
    - a) Override door from the software web interface.
    - b) Override door via triple swipe action at reader.
    - c) Override door via auxiliary input action.
    - d) Override door via Crisis Levels feature.
  - 7) Ability to pulse a door to unlock from any page in the software web interface.
24. Elevator management shall provide the following:
- a. Ability to manage up to 64 floors per elevator cab per Elevator Master Panel.
  - b. Ability to apply a specific name and description to each cab, reader, and floor.
  - c. Ability to manage up to 4 cab per Elevator Master Panel.
  - d. Ability to configure if an individual cab is using button sensing elevator technology.
  - e. Ability to apply a time zone to control when a specific Floor is to unlock/lock, accept cards.
  - f. Ability to apply a Holiday group to control how a specific floor will behave on a Holiday.
  - g. Ability to generate floor to output map for wiring and diagnostic purposes.
  - h. Ability to assign readers to 2 cabs.
  - i. Ability to configure up to 4 cabs on schedules without readers.
  - j. Floor Override:
    - 1) Ability to deviate the state of a floor from the normal schedule.
    - 2) Ability to override a floor until explicitly resuming the normal schedule.
    - 3) Ability to override the state of a floor and instruct the controller to resume the normal schedule once the floor is scheduled to change state. The floor will resume normal schedule after that.

- 4) Ability to resume a floor to its normal schedule regardless of override method.
  - 5) Ability to override a door through the following methods:
    - a) Override floor from the software web interface.
    - b) Override floor using the API.
  - k. Override floor using the Action Control Engine (ACE).
25. Panel management shall provide the following:
- a. Ability to apply a specific name and description to each door/elevator panel.
  - b. Ability to assign a panel to a specific partition.
  - c. Ability to configure a password code for accessing the panel LCD interface and panel web interface.
  - d. Ability to disable/enable the web interface of the panel for remotely configuring IP settings.
  - e. Ability to configure the panel connection mode as static IP or DHCP.
  - f. Ability to configure the LCD screen on the panel, brightness and on time.
  - g. Ability to configure how long a forced open buzzer lasts.
  - h. Ability to configure the panel tamper sensor sensitivity and disable/enable.
  - i. Ability to configure how the integrated motion behaves, along with sensitivity options.
  - j. Panel Inputs and outputs are 100 percent configurable; all inputs/outputs can be configured as normally open or normally closed, supervised, events enabled/disabled.
  - k. Ability to configure Inputs as any of the following functions: Request to Exit, Door Contact, Door Opener to exit, Motion Sensor, Emergency alarm, External Alarm Status, Door Opener to Enter, Man Trap Input. Aux Input action: Toggle/Activate/Pulse selected output. Toggle/Activate/Pulse alarm interface. Override doors with Crisis Level. Play Sound.
  - l. Ability to configure Outputs/Relays as any of the following functions: Door Strike, Door Opener, External Buzzer, Alarm Interface, Aux Output, Secondary Door Strike, Door Unlocked or Open.
  - m. Ability to place panel into debug mode for diagnostics, troubleshooting and additional logging.

- n. Ability to view in real time the following information:
    - 1) Real time door contact status (open or closed).
    - 2) Real time if the door is in an overridden state.
    - 3) Real time mode of the door (card mode, unlocked).
  - o. Ability to unload an update to an individual panel.
  - p. Ability to request a panel show its currently known time.
  - q. Ability to reset anti-passback locations of users on a specific panel.
  - r. Ability to request a panel to disconnect from the server for a period of time.
  - s. Ability to manually place a panel into firmware update mode.
  - t. Output Override:
    - 1) Ability to deviate the state of an output from the normal state (open or closed).
    - 2) Ability to override an output until explicitly resuming to its normal state.
    - 3) Ability to resume an output to its normal state regardless of override method.
    - 4) Ability to override an output through the following methods:
      - a) Override output from the software web interface.
      - b) Override output via triple swipe action.
      - c) Override output via aux input function.
      - d) Override output from API or script engine (ACE).
26. Microsoft Active Directory (AD) Integration via LDAP protocol:
- a. Ability to obtain read only directory information from LDAP provider.
  - b. Ability to synchronize AD Users based on selected AD Security Groups.
  - c. Ability to choose which AD Security Groups AD Users will be synchronized from.
  - d. Ability to configure AD Security Groups as Access Privilege Groups.
  - e. Ability to give access to Doors/Floors based on AD Security Group membership.

- f. Ability to synchronize the following AD User information: First Name and last name, User Expiry Date: Expired Users will have access rights to Doors/Floors removed. User Status (enabled/disabled): Disabled Users will have access rights to Doors/Floors removed. AD Group membership.
  - g. Ability to synchronize credentials (Card/FOB/PIN) via AD User Attribute Fields.
  - h. Ability to synchronize credentials in the following manners: Wiegand Credential from Single AD Attribute Field. Wiegand Credential from 2 individual fields with Fixed Site Code. Wiegand Credential from three Individual Fields. PIN from single field.
  - i. Ability to synchronize AD User Attributes as Custom Fields.
  - j. Ability to configure how often Protector.Net checks the LDAP provider for changes (1 to 60 minutes).
  - k. Ability to automatically disable Users who have been deleted or disabled in Active Directory without panel update required.
  - l. Ability to filter AD groups by root OU.
27. VAX Data Management:
- a. Software shall provide the ability to perform automatic database backup to a location selected by the administrator.
  - b. Ability to backup user profile pictures along with database backup.
  - c. Backup locations shall include:
    - 1) Shared network drive.
    - 2) External USB drive.
    - 3) Folder on local hard drive.
  - d. Ability to compress database backups for better space utilization.
  - e. Ability to encrypt a backup with a definable password.
  - f. Software shall provide the capability to manually back up the database to a selected location.
  - g. Ability to automatically remove backups older than a defined period of days in the backup directory.
  - h. Availability of a database restore utility that can be performed via web browser.

- i. Ability to stop/start/restart the web service through management web interface.
  - j. Software shall include system tray application that shows status of web service and provides control to stop/start the web service.
  - k. Ability to remotely change network settings on remote server hosting the web service.
  - l. Ability to purge old alerts/notifications based on data retention period.
  - m. Data Migrator: Enables the export and import of data between partitions and systems.
  - n. Database Warning Size Menu: Allows the setup of an alarm to notify when a set present of the 10 GB SQL 2012 database is reached.
28. VAX Software Registration Management:
- a. Software registration directly through dealer or the manufacturer.
  - b. Ability to manage and view the following licensing information from web interface:
    - 1) View current license package.
    - 2) View expiry date of license.
    - 3) View license features and limitations.
  - c. Software shall provide 30 day warning prior to software license expiration.
  - d. Software shall provide 10 day grace period after software license expiration if no administrator has logged in since the license expired.
  - e. Software shall provide life safety features if the license is expired, and the grace period is over.
29. Assa Abloy Aperio Integration:
- a. Software shall provide unified management of Aperio devices.
  - b. Ability to communicate with up to 8 Aperio wireless locks per Aperio controller.
  - c. Ability to store 100,000 users, bypasses Aperio 2,000 user limitation.
  - d. Cabinet or door locks supported.
  - e. Ability to share time schedules between regular door controllers an Aperio controllers.

30. Health Monitoring:
  - a. There shall be a full set of tools to maintain the health of the system.
  - b. A comprehensive list of events shall be provided in the Health Settings section, including Actions to be taken in the event there is a change to the value the Health Settings is monitoring.
  - c. Health History reporting tool shall allow the Administrator to view events related to the health and upkeep of the system, including Health Issue Filtering choices and Status and Severity.
  - d. The ability to keep track of updates, backups, storage space and battery power shall be provided.
  
31. Software Navigation and Contextual Help:
  - a. Offer contextual help file by hovering over fields, check boxes, drop-down menus.
  - b. Ability to place objects into list format (such as panels, doors, user) for conducting comparisons between objects.
  - c. Ability to edit attributes of objects from the list view.
  - d. Software shall offer comprehensive documentation can be accessed through web interface or accessed via start menu shortcut on host web server.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals.

### 3.4 PROTECTION

- A. Protect installed products until completion of project. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 282300

**SUPPLEMENTARY SPECIFICATIONS**  
**FOR THE NEW PAVILION AT HADDON LAKE PARK**  
**IN THE BOROUGH OF HADDON HEIGHTS**  
**COUNTY OF CAMDEN**

**AUTHORIZATION OF CONTRACT**  
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The contract for this project is authorized by the provisions of local public contracts law, NJSA 40A: 11-1 et seq.

**SPECIFICATIONS TO BE USED**  
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The electronic version of the 2019 Standard Specifications for Road and Bridge Construction, effective September 1, 2019 as referenced in Baseline Document Change announcement BDC19S-01 of the New Jersey Department of Transportation and as amended herein, shall govern the construction of this project.

**WAGE RATES**  
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The contractor shall pay the minimum wage rates determined by the New Jersey Department of Labor.

State wage rates may be obtained from the New Jersey Department of Labor (Telephone: 609-292-2259) or by accessing the Department of Labor's web site at:

[http://lwd.dol.state.nj.us/labor/wagehour/wagehour\\_index.html](http://lwd.dol.state.nj.us/labor/wagehour/wagehour_index.html).

The State wage rates in effect at the time of award will be made a part of this Contract, pursuant to Chapter 150, Laws of 1963 (NJSA 34:11-56.25, *et seq.*).

In the event it is found that any employee of the contractor or any subcontractor covered by the contract, has been paid a rate of wages less than the minimum wage required to be paid by the contract, the contracting agency may terminate the contractor's or subcontractor's right to proceed with the work, or such part of the work, as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise. The contractor and his sureties shall be liable to the contracting agency for any excess costs occasioned thereby.



## **GENERAL**

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Award of contract and subletting will not be permitted to, materials will not be permitted from, and use of equipment will not be permitted that is owned and/or operated by, firms and individuals included in the report of suspensions, debarments and disqualifications of firms and individuals as maintained by the Department of the Treasury, General Services Administration, CN-039, Trenton NJ 08625 (609-292-5400).

Payment for a pay item in the proposal includes all the compensation that will be made for the work of that item as described in the contract documents unless the "basis of payment" clause provides that certain work essential to that item will be paid for under another pay item.

Whenever any section, subsection, subpart or subheading is amended by such terms as changed to, deleted or added it is construed to mean that it amends that section, subsection, subpart or subheading of the 2019 Standard Specifications unless otherwise noted.

Whenever reference to page number is made, it is construed to refer to the 2019 Standard Specifications unless otherwise noted.

Henceforth in this supplementary specification whenever reference to the State, Department, ME, RE or Inspector is made, it is construed to mean the particular municipality or county executing this contract.

Whenever reference to Title 27 is made, it is construed to mean Title 40.

## DIVISION 100 – GENERAL PROVISIONS

### SECTION 101 – GENERAL INFORMATION

#### 101.01 INTRODUCTION

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

Whenever any Section, Subsection, Subpart or Subheading is amended by such terms as changed to, deleted or added, etc., it is construed to mean that it amends that specific Section, Subsection, Subpart or Subheading of the 2019 Standard Specifications unless otherwise noted.

Whenever reference to page number is made, it is construed to refer to the 2019 Standard Specifications unless otherwise noted.

Henceforth in this supplementary specification whenever reference to the State, Commissioner, Department, Engineer or Inspector is made, it is construed to mean the particular municipality or County executing this contract.

#### 101.03 TERMS

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

All references to "Commissioner", "Department" or "State" shall be interpreted to mean "County". All references to "Engineer" shall be interpreted to mean "County Engineer".

All references to "Standard Specifications" shall be interpreted to mean the *Standard Specifications for Road and Bridge Construction 2019* as published and amended by the New Jersey Department of Transportation.

The following terms and their meanings are added to this Subsection of the Standard Specifications:

**County business day:** a calendar day, exclusive of Saturdays, Sundays, State recognized legal holidays, and other such holidays or County office closings as declared by the Camden County Board of Chosen Freeholders.

#### 101.04 INQUIRIES REGARDING THE PROJECT

THE SUBSECTION OF THE STANDARD SPECIFICATIONS IS DELETED AND REPLACED WITH THE FOLLOWING:

Submit inquiries regarding discrepancies, errors, or omissions, or concerns regarding the intent or meaning of the Contract to the Department as follows:

1. Before Award of Contract.

**The deadline for submitting inquiries prior to bid is 12:00 P.M., March 25, 2024. Submit inquiries in writing.**

Inquiries prior to bids in accordance with this Subsection shall be addressed to:

Jessica Hauber, PE  
Remington & Vernick Engineers  
2059 Springdale Road  
Cherry Hill, NJ 08003  
Telephone: 856-795-9595  
Fax: 856-216-0919  
Email: [jessica.hauber@rve.com](mailto:jessica.hauber@rve.com)

All inquiries shall include the following:

- a. Name of the company
- b. Telephone number, fax number and contact person
- c. Specifics of the inquiry, including anticipated impacts.

The Department will investigate the information provided in the inquiry and, if the Department determines that a change or response is necessary, the Department will issue an addendum.

Requests for postponement of bids will not receive a response. The Department will issue an addendum postponing bids if warranted.

2. After Award of Contract.

Inquiries shall be addressed to:

Jessica Hauber, PE  
Remington & Vernick Engineers  
2059 Springdale Road  
Cherry Hill, NJ 08003  
Telephone: 856-795-9595  
Fax: 856-216-0919  
Email: [jessica.hauber@rve.com](mailto:jessica.hauber@rve.com)

## **SECTION 102 – BIDDING REQUIREMENTS & CONDITIONS**

THIS SECTION OF THE STANDARD SPECIFICATIONS IS DELETED.

## **SECTION 103 – AWARD AND EXECUTION OF CONTRACT**

### **103.01 AWARD OF CONTRACT**

In line 3 change "30 State" to "60 County"

### **103.04 EXECUTION OF THE CONTRACT**

PARAGRAPH TWO (2) IS TO BE REMOVED AND REPLACED WITH:

The Contract shall be signed by the successful bidder and returned, together with the Performance Bond and Payment Bond, within (ten) 10 County business days of the date of award or conditional award of the Contract. If the Contract is not executed by the Department within (fifteen) 15 County business days following receipt from the bidder of the signed Contract and Performance Bond and Payment Bond, the bidder shall have the right to withdraw his bid without penalty. The Contract shall not be considered as effective until it has been fully executed.

## **SECTION 104 – SCOPE OF WORK**

### **104.01 INTENT**

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

The work to be performed under this contract shall consist of the construction of a new pavilion building consisting of a multi-purpose room, changing room, utility room and outdoor covered patio. It also consists of the construction of new concrete sidewalk, grading, stormwater improvements and utility work, as well as the installation of topsoil, seed, and landscaping.

### **104.02 VALUE ENGINEERING**

THIS SUBSECTION OF THE STANDARD SPECIFICATIONS IS DELETED.

### **104.03 CONTRACTURAL NOTICE**

THE SECOND PARAGRAPH IS CHANGED TO:

Immediately provide written notice to the RE of a circumstance that is believed to be a change to the Contract. Include the following in the initial written notice:

1. A statement that this is a notice of a change.
2. The date when the circumstances believed to be a change were discovered.
3. A detailed and specific statement describing the nature and circumstances of the change.
4. If the change will or could affect costs to the Department.
5. If the change will or could affect Contract Time as specified in 108.11.01.C.

In addition to the hard copy of the notice, email the notice to the RE. It is not necessary to attach listed documents to the email.

## **SECTION 105 –CONTROL OF WORK**

### **105.04 PLANS AND SPECIFICATIONS**

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

Supplementary Specifications for the project and the Standard Specifications form a part of the Contract and are on file in the Office of the County Engineer, 2311 Egg Harbor Road, Lindenwold, NJ 08021. The successful Bidder will be furnished with one (1) additional set of Supplementary Specifications.

### **105.05 WORKING DRAWINGS**

THE SECOND PARAGRAPH IS CHANGED TO:

Ensure that working submissions also conform to the Department design manuals and other Department standards for the proposed work. Six copies of the working drawing submissions shall be submitted to the RE on 8½" by 11½" paper, unless the submission is a physical material submission for approval/selection by the Department. Working drawings shall not be submitted to the Department via email.

### **105.07 COOPERATION WITH UTILITIES**

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

Bidders are hereby notified of the information available regarding the existing utility structures which may be encountered within and adjacent to the limits of the work and of the corporations owning or controlling them.

The contractor shall also comply with the State's underground facility protection act and notify the State's one call system and identify itself as the State's contractor and specify the route and section number of the project before performing work on the project. The one call system can be reached by calling 1-800-272-1000.

### **UTILITIES**

Telephone Lines

Verizon  
298 S White Horse Pike  
Audubon, NJ 08106  
856.546.8080

Comcast  
1250 Haddonfield-Berlin Road  
Cherry Hill, NJ 08034  
Attention: Mike McCabe  
856.258.0096

Gas Lines

PSE&G  
611 E Atlantic Avenue  
Haddon Heights, NJ 08035  
800.436.7734

Electric Lines                      PSE&G, Electric T&D  
300 New Albany Road  
Moorestown, NJ 08057  
856.778.6850

Water lines                         NJ American Water  
500 Grove Street  
Haddon Heights, NJ 08035  
856.547.3211

Sewer                                Borough of Haddon Heights  
514 W Atlantic Avenue  
Haddon Heights, NJ 08035  
856.546.2580

Cable                                Comcast Cable  
1250 Haddonfield-Berlin Road  
Cherry Hill, NJ 08034  
Attention: Mike McCabe  
856.258.0096

Bidders are advised to verify this information as its accuracy and completeness are not guaranteed by this Department.

The locations and information regarding subsurface utilities are not guaranteed by this Department and the Contractor shall ascertain the location and depth of all utilities by his own investigation and determine on the site of the work and from information from the respective owners of the utilities.

The Contractor shall prosecute his work carefully and skillfully and he shall exercise the necessary precautions and employ such procedures and methods as may be necessary to protect these utilities from damage.

The Contractor shall cooperate with the Utility Companies in the protection and any necessary adjustments of their facilities.

Before the Contractor begins any work or operation he shall carefully locate existing structure and conduct his operations to avoid damaging it. If the Contractor wishes to have any utilities relocated for his own convenience, he shall make the necessary arrangements with the owners and reimburse them at his own expense for the cost of the work.

The Contractor shall permit the owners of utilities access to the site at all times to relocate or protect their lines and he shall cooperate with them in every way.

The Contractor shall notify the Utility Company well in advance of the time he proposes to perform any work which would endanger their facilities during the construction operation.

No specific payment will be made for the maintaining relocating and protecting of utilities except as specifically provided herein and all cost of this work will be assumed to have been included items of the Contract.

Whenever utility services are encountered in which the private property owner also directly owns the utility service, said utility service shall be relocated by the Contractor. Separate payment will not be made for this relocation but all such costs shall be included in the unit prices bid for the various items of the Contract as listed in the Proposal.

Whenever the temporary relocation or temporary support of public or private facilities is necessitated in order to complete the Project, all such temporary relocation or temporary support costs shall be borne by the Contractor.

When water, sewer and gas house connections, boxes, cleanouts and valves must be relocated or replaced to carry out this Project, the cost of such work shall be included in the prices bid for the various pay items.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, utility manholes, light standards, cableways, signals, railroad lines all other utility appurtenances within the limits of the project which are to be relocated or adjusted are to be moved by the owners at their expense, except as otherwise provided for in the Supplemental Specifications or as noted on the Plans.

The Contractor shall be responsible to provide water, for any purpose, at his own expense. The Contractor shall be responsible for providing uninterrupted water service to each home in the project area at all times.

The Contractor shall be responsible for locating all existing structures and utilities, which the Contractor deems necessary, both above and below the ground surface before equipment enters the construction site.

The Contractor shall make final inquiries to Underground Utilities telephone number 1-800-272-1000 within seven (7) days of entering the site. The Contractor shall coordinate and verify the method of utility locations with the appropriate utility company.

If a Utility is to be relocated, the Contractor will be responsible for paying all fees required by the Utility Company due to the relocation. The County will not be responsible for any down time incurred by the Contractor due to the Utility Company work.

**105.07.01.C Working in the Vicinity of Utilities**

THE SECOND PARAGRAPH IS CHANGED TO:

Protect and support existing Department electrical and ITS facilities and ensure that there is no interruption of service. Use hand tools only while working within two feet of the fiber optic network. At least 30 days before beginning the work, submit a plan to the RE for approval showing the method of support and protection.

THE FOLLOWING IS ADDED TO THE SIXTH PARAGRAPH:

Access within railroad right-of-way is restricted. Comply with the railroad’s permit requirements for working within the railroad right-of-way. Coordinate the work with the railroad’s access and safety restrictions.

**105.08 ENVIRONMENTAL PROTECTION**

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

**105.11 TEMPORARY PROJECT WATER POLLUTION CONTROL (SOIL EROSION)**

At the Pre-construction Conference or prior to the start of the applicable construction, the Contractor shall submit for acceptance his schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing; grading; bridges and other structures at watercourses; construction; and paving. He shall also submit for acceptance his proposed method of erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer.

**105.12 PRE-CONSTRUCTION VIDEO RECORD**

*PRE-CONSTRUCTION VIDEOGRAPHIC RECORD*

*Prior to the start of construction, the Contractor must prepare and submit to the County a videographic record, in DVD format, of the existing conditions of the roadway and the adjacent property including but not limited to roadway pavement, curb, curb berth w/trees, driveways, driveway aprons, sidewalk, service walks, fencing, electrical lighting, freestanding mailboxes, any landscaping within the County R.O.W., any anomalies or irregularities, identify adjacent house numbers and cross streets. There will be no specific payment for this DVD record. Payment for this record shall be included in the total amount bid for the items within the proposal.*



## SECTION 106 – CONTROL OF MATERIALS

THE FOLLOWING IS ADDED TO THIS SECTION OF THE STANDARD SPECIFICATIONS:

The Contractor shall supply the County with Letters of Certifications from the Manufacturer or Supplier of materials used on the project stating that the materials conform to the Supplementary Specifications of the New Jersey State Highway Department Standard Specifications for 2019.

### 106.03 MATERIALS, INSPECTIONS, TEST AND SAMPLES

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

The County shall engage the services of a Certified Testing Laboratory to obtain the required number of samples and/or test cores and perform all the necessary testing as required by the specifications for the following materials:

- test cores for conformance to job mix formula, air void content and thickness requirements.
- test cores for conformance to job mix formula and air void content.
- samples for conformance to job mix formula.
- samples for soil aggregate designation Dense Graded Aggregate

The size of samples shall be as required by the testing laboratory, test cores will be 8" in diameter.

The Contractor shall supply the County with Letters of Certifications from the Manufacturer or Supplier of materials used on the project stating that the materials conform to the Supplementary Specifications of the New Jersey State Highway Department Standard Specifications for 2019.

The County requires a Level II Certified Asphalt Plant Technologist to be present at the asphalt supplier's plant. This Technologist will be supplied and approved by the County Engineer. It is the Contractor's responsibility to notify the Camden County Engineer as well as the Level II Certified Asphalt Plant Technologist for the County of Camden at least 72 hours prior to any paving activities. NO PAVEMENT ACTIVITY can occur without the presence and approval of the Level II Certified Asphalt Plant Technologist.

THE ENTIRE SECOND PARAGRAPH SHALL BE CHANGED TO:

All materials being used are subject to inspection, testing, or rejection at any time prior to acceptance of the project. Samples will be taken by a representative of the Department. Results of tests made with Certified Testing Laboratory apparatus conforming to the requirements specified in the prescribed methods of test shall be official and copies of test results will be furnished upon request.

State of New Jersey approved job mix formula shall be submitted to the County before the beginning of the project.

A lot shall be considered 15,000 SQUARE YARDS OR FRACTION THERE OF (N) equals the number of cores required per lot 5.

THE FOLLOWING IS ADDED TO THIS SECTION OF THE STANDARD SPECIFICATIONS:

#### **106.10 STORAGE OF MATERIALS AND EQUIPMENT**

Materials shall be stored to assure the preservation of their quality and fitness. Stored materials, even though approved before storage, may again be inspected prior to their use on the Project. Stored materials shall be located so as to facilitate their prompt inspection. With the approval of the Engineer, portions of the right-of-way within the project area may be used for storage purposes and for the placing of the Contractor plant and equipment. Private property shall not be used for storage purposes without written permission of the owner or lessee. Copies of such written permission shall be furnished to the Engineer prior to storage. Storage sites shall be restored to their original condition at no cost to the Owner.

No specific payment will be made for Storage of Materials and Equipment. The cost thereof shall be included in the prices bid for the various items scheduled in the Proposal.

### **SECTION 107 – LEGAL RELATIONS**

#### **107.01.02 Permits, Licenses, and Approvals**

THE FOLLOWING IS ADDED TO THIS SUBPART OF THE STANDARD SPECIFICATIONS:

No work may begin until all permits have been received.

The Contractor is put on notice that all permits necessary and required under the State specifications, EPA, OSHA Regulations, NIOSH recommendations, State of New Jersey regulations and any other applicable federal, state and local government regulations must be obtained prior to commencement of work.

The contractor shall obtain and pay for all necessary permits, including, but not limited to, municipal Road Opening Permits if required. No separate payment will be made for permits. All costs thereof shall be included in the various items of the proposal.

The contractor shall file and obtain a Camden County Road Opening Permit, however, the Contractor shall request a permit fee waiver upon application. Camden County will waive the Road Opening permit fee.

The Sales Tax exemption does not apply for equipment used for contract work or for force account work whether the equipment is to be purchased or rented.

A written notice of proposed roadway improvements shall be delivered by the Contractor to all residences and businesses encompassed in the area. This notice shall contain the date the improvements are to be done and the Contractor's name, telephone number and address. This notice is to be delivered to the residences and businesses no later than 48 hours prior to the commencement of work. If the work is canceled for any reason these notices are to be reissued to all the residences showing the new date and again no later than 48 hours prior to the commencement of operations.

The Department shall have a copy of the contractor's notice to residents 72 hours prior to the start of the work. If the Department does not have a valid copy of this notice to the residents and businesses at least 72 hours prior to the commencement of work, no work will be allowed to commence until this item is satisfied.

No specific payment will be made for this notification; cost thereof should be included in various proposal items.

## **SECTION 108 – PROSECUTION AND COMPLETION**

### **108.01 SUBCONTRACTING**

THE FOLLOWING IS ADDED TO THIS SECTION OF THE STANDARD SPECIFICATIONS:

The department will not permit subcontractors without prior approval. In addition to the documentation required under Section 108.01, the contractor shall provide a list of all proposed subcontractors for the project with the bid package.

#### **1. Values and Quantities.**

**Specialty items are listed below:**

**Electrical Wire Items.**

**Water Service Items.**

THE THIRD PARAGRAPH IS CHANGED TO:

If a partial quantity of work for a unit price Item is subcontracted, the Department will determine the value of the work subcontracted by multiplying the price of the Item by the quantity of units to be performed by the subcontractor.

THE FOURTH PARAGRAPH IS CHANGED TO:

If only a portion of work of an Item is subcontracted, the Department will determine the value of work subcontracted based on the value of the work subcontracted as indicated in the subcontract agreement and as shown in a breakdown of cost submitted by the Contractor.

### **108.02 COMMENCEMENT OF WORK**

DELETE FIFTH PARAGRAPH AND SUBSTITUTE THE FOLLOWING:

The Contractor shall commence work within ten (10) calendar days after date of mailing fully executed Contract and shall continue without interruption until the work is completed unless otherwise directed by the Camden County Director of Public Works. The Contractor shall give the Engineer not less than three (3) days notice of the time and place or places he will start the work.

ADD THE FOLLOWING TO THIS ARTICLE:

Any nighttime operations after normal working hours or weekend or holiday operations that require the presence of County Inspection and/or engineering personnel shall include any compensation for said personnel. The necessity of their presence shall be directed by the Engineer. The contractor shall be responsible for the compensation.

The Contractor agrees that he shall have no right to nor shall he make any claim whatsoever for damage or additional compensation by reason of the Engineer revising the stage construction or the maintenance of traffic requirements of the Contract. An extension of time may, however, be granted if appropriate under Subsection 108.11.01

Any existing traffic signal shall remain in operation in order to assist in the safe passage of vehicles.

### **108.10 CONTRACT TIME**

THIS SUBSECTION OF THE STANDARD SPECIFICATIONS IS DELETED AND REPLACED WITH THE FOLLOWING:

**The project must be substantially completed in Ninety (90) Calendar Days.** Substantial Completion is met when all work is complete, with the exception of landscaping Items listed in 811.04, removal of SESC measures, FINAL CLEANUP, and repair of unacceptable work; provided the RE has determined that:

1. The Project is safe and convenient for use by the public.
2. Failure to complete work and repairs excepted above will not result in the deterioration of other completed work.
3. The value of the remaining landscaping work, removal of SESC measures, repairs, and FINAL CLEANUP is less than 2 percent of the Total Adjusted Contract Price.

**The entire project must be completed in One-Hundred Twenty (120) Calendar Days.** Completion is met when all of the following have occurred:

1. The Work has been satisfactorily completed in all respects according to the Contract.
2. The Project is ready for use by the Department as required by the Contract.
3. The Contractor has satisfactorily executed and delivered to the RE all documents, certificates, and proofs of compliance required by the Contract including the Notice of Completion.

### **108.11 MODIFICATIONS TO CONTRACT TIME**

#### **108.11.01 EXTENSIONS TO CONTRACT TIME**

ADD THE FOLLOWING TO THIS ARTICLE:

When the Contractor deems that additional compensation or extension of time is due him for work required to be performed or materials required to be furnished which in his opinion cannot be classified under the schedule items of work and which have not been covered by a Change Order as hereinafter specified in Article 104.03 and it is his intention to make claim therefore, he shall notify the Engineer in writing of such intention before he begins the work or furnishes the materials in question. If such notice be given the Engineer shall be afforded the opportunity to modify the design or construction procedure, or both, before the Contractor begins the work or furnishes the materials in question, and the opportunity and proper facilities for keeping account of the actual cost of such work and materials after the work begins. If such notice be not given, in writing, or if the Engineer be not afforded such opportunity and facilities, then the Contractor shall and hereby agrees to waive the claim for such additional compensation or extension of time or both. However, if the Contractor has complied with all the foregoing provisions, this circumstance in no way shall be construed as proving the validity of the claim.

The claim will be passed on by the Engineer, and if he finds it to be justifiable under the provisions of the Contract, the work or materials in question will be paid for under an appropriate Change order. Attention is directed to the provisions of Article 104.03 and 109. regarding limitation of increase and reduction of quantities of major schedule items.

Extension of time stipulated in the Contract for completion of the project will be made if and as the Engineer may deem proper, when work under a Change order as herein-after provided is added to the work of the Contract, when the work is suspended as provided in Article 108.13,14,15 and when the work of the Contractor is delayed on account of conditions, other than daily weather conditions which in the opinion of the Engineer warrant such extension; provided however, that no extension on account of delay will be granted unless notice of such delay and of the Contractor's intention to claim an extension of time be given the Engineer, in writing, within five (5) days after the beginning of such delay, and said notice shall give complete information of the nature, cause and probable extent of the delay. Extensions of time shall be binding only when issued in writing.

**108.15 TERMINATION OF CONTRACT**

THE FOLLOWING IS ADDED TO THIS SUBSECTION OF THE STANDARD SPECIFICATIONS:

The County also reserves the right to terminate the Contract or any portion thereof, at any time, upon a determination by the County Engineer, in his sole discretion, that such termination is in the best interests of the County.

**108.19 COMPLETION AND ACCEPTANCE**

THE FOLLOWING IS ADDED:

No Incentive Payment for Early Completion is specified for this project.

THE FIRST PARAGRAPH IS CHANGED TO:

Notify the Department, in writing, when the Work is complete. When the Department receives written notice, the Department will perform an inspection. If the Department determines that the Work is complete, the Department will prepare a Final Change Order; obtain Freeholder Approval of the Final Change Order and make Final Payment with release of retainage.

THE SECOND PARAGRAPH IS CHANGED TO:

If the Department determines that the Work is not complete, the Department will respond within 30 days and provide the Contractor with the necessary instructions for completion and correction. Final Inspection by New Jersey Department of Transportation will be according to their availability and schedule. The New Jersey Department of Transportation may provide comments and instructions for corrections separate from the Department. Complete the Work and re-notify the Department. Repeat this procedure until all of the Department and New Jersey Department of Transportation comments and instructions (punch list) are completed and no corrective action is required.

THE THIRD PARAGRAPH IS CHANGED TO:

The date of the Department Final Payment Check Date is the date of Completion and date of Acceptance.

THE FOURTH PARAGRAPH IS CHANGED TO:

After Acceptance, the Contractor is relieved of the duty of maintaining and protecting the project.

In addition, the Contractor is relieved of its responsibility for damage to the work that may occur beyond one full year after Acceptance.

### **108.20 LIQUIDATED DAMAGES**

THIS SUBSECTION OF THE STANDARD SPECIFICATIONS IS DELETED AND REPLACED WITH THE FOLLOWING:

The Contractor and the Department recognize that delay in completion results in damages to the County in terms, the effect of the delay on the use of the Project, upon the public convenience and economic development of the Department and also results in additional costs to the Department for engineering, inspection, police traffic control and administration of the Contract. Because it is difficult or impossible to accurately estimate the damage incurred; therefore, the parties agree that if the Contractor fails to complete the Contract within the time stated in these Special Provisions, or within such further time as may have been granted to the provisions of the contract, the Contractor shall pay the Department liquidated damages as provided below. Such liquidated damages shall be paid for each and every calendar day that the Contractor is in default to complete the Contract.

For each day that the Contractor fails to achieve Completion as specified in Section 108.10 in this Section, the Department will assess liquidated damages in the amount of **\$500.00** per calendar day.

## **SECTION 109 – MEASUREMENT AND PAYMENT**

### **109.01 MEASUREMENT OF QUANTITIES**

THE SECOND PARAGRAPH IS DELETED

### **109.05 ESTIMATES**

THE EIGHTH PARAGRAPH OF THIS SUBSECTION OF THE STANDARD SPECIFICATIONS IS AMENDED TO READ AS FOLLOWS:

From the total amounts ascertained as payable, an amount equivalent to 2 percent of the amount due will be deducted and retained pending completion of all work under the contract.

### **NEW JERSEY PREVAILING WAGE ACT**

The Contractor shall pay the Minimum Wage Rates determined by the New Jersey Department of Labor.

State wage rates may be obtained from the New Jersey Department of Labor (telephone 609-292-2259). The State Wage Rates in effect at the time of award will be made a part of this Contract pursuant to Chapter 150, Laws of 1963 (NJSA 34:11-56.25 et seq.).

In the event it is found that any employee of the Contractor or any subcontractor covered by the Contract has been paid a rate of wages less than the minimum wage required to be paid by the Contract., the County may terminate the Contractor's or subcontractor's right to proceed with the work or such part of the work as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise. The Contractor and his sureties shall be liable to the County for any excess costs occasioned thereby.

## **DIVISION 150 – CONTRACT REQUIREMENTS**

### **SECTION 151 – PERFORMANCE BOND AND PAYMENT BOND**

THIS SECTION OF THE STANDARD SPECIFICATIONS IS DELETED.

### **SECTION 152 – INSURANCE**

THIS SECTION OF THE STANDARD SPECIFICATIONS IS DELETED.

### **SECTION 153 – PROGRESS SCHEDULE**

#### **153.03.03 Bar Chart Progress Schedule and Updates**

THIS SECTION OF THE STANDARD SPECIFICATIONS IS DELETED AND REPLACED WITH THE FOLLOWING:

##### **A. Schedule**

Provide a detailed bar chart schedule showing the most feasible work sequence that meets the Contract requirements. Ensure that the schedule includes ROW availability dates, permits, submittals, working drawings, procurement, fabrication, delivery of materials, construction, and other activities necessary to complete the Work. Schedule the Work to complete the project within the contract completion duration specified by the Contract.

The bar chart schedule does not constitute notice and does not satisfy the notice requirements as specified in 104.03.04. Approval of the schedule by the RE does not modify the Contract or constitute Acceptance of the feasibility of the Contractor's logic, activity durations, or assumptions used in creating the schedule. If the schedule reflects a completion date different than that specified in 108.10, this does not change the specified completion date. If the RE approves a schedule that reflects a completion date earlier than that specified as the Contract Time, the Department will not accept claims for additional Contract Time or compensation as the result of failure to complete the Work by the earlier date shown on the CPM schedule.

Ensure that the bar chart schedule approval includes the following:

1. Provide 1 activity for each discrete component of work
2. Provide activity descriptions to ensure that the status of work is readily identifiable.
3. No construction activity shall have a construction duration greater than 30 days, unless approved by the RE.
4. Identify the critical work path on the bar schedule.
5. Include time frames when work is restricted in sensitive areas, such as wetlands, floodplains.
6. Ensure that seasonal constraints are reflected for items of work such as seeding and planting.
7. Ensure that the progress schedule is of suitable scale to clearly indicate the duration of each activity.

Submit 6 paper copies of the baseline schedule to the RE for approval. The Notice to Proceed will not be issued and construction operations cannot begin until the RE approves the baseline schedule submission. Allow 14 days for the RE to review and approve or reject and return the baseline schedule submission. If the baseline schedule submission is rejected by the RE, revise and resubmit to the RE for approval within 7 days.

## **B. Updates**

Update the progress schedule to reflect changing conditions for each project progress meeting. At the progress review meeting, present and review the progress since the previous progress meeting and the work anticipated before the next scheduled progress meeting.

Provide a minimum of 6 copies of the bar chart schedule update to the RE at each progress meeting. Ensure that each schedule update conforms to the scheduling requirements specified in 153.03.03 and includes the following:

1. One activity for each discrete component of work remaining.
2. Activity descriptions to ensure that the status of work is readily identifiable.
3. Identify current and anticipated delaying problem areas and their estimated schedule effect.
4. Identify the status of all milestones specified in the Contract.
5. Identify the schedule slippage, pay revisions, and progress along the critical path of days ahead or behind previously established dates approved in the initial bar chart schedule.

Within 7 days, the RE will review the update schedule and approve or reject the submission. If rejected, revise and resubmit the schedule update, within 7 days, to the RE for review and approval. The RE will review the revised schedule update submissions and approve or reject the resubmission within 7 days.

### **153.04 MEASUREMENT AND PAYMENT**

THIS SUBSECTION OF THE STANDARD SPECIFICATIONS IS DELETED AND REPLACED WITH THE FOLLOWING:

The Department will not measure and will not make payment for Schedule and Updates. The cost of Schedule and Updates shall be included in the various Items scheduled in the Proposal.

## **SECTION 154 – MOBILIZATION**

### **154.04 MEASUREMENT AND PAYMENT**

This section is changed to:

The Department will not measure and will not make payment for Mobilization.

If Mobilization is not included in the proposal, include the costs in the various Items scheduled in the Proposal.



## SECTION 157 – CONSTRUCTION LAYOUT AND MONUMENTS

### 157.04 MEASUREMENT AND PAYMENT

The following pay item is DELETED:

<i>Item</i>	<i>Pay Unit</i>
CONSTRUCTION LAYOUT	LUMP SUM

The following is added to this section:

The Department will not make payment for Construction Layout. The costs associated with Construction Layout shall be included in the various Items scheduled in the Proposal.

## SECTION 158 – SOIL EROSION AND SEDIMENT CONTROL AND WATER

### SOIL EROSION AND SEDIMENT CONTROL

#### THE PROVISIONS OF THE 2019 NJSSRBC SHALL GOVERN THIS SECTION:

THE FOLLOWING SHALL BE ADDED TO THIS SECTION:

#### 158.01 DESCRIPTION

Soil Erosion Control shall include the installation and maintenance of inlet sediment control devices and the carrying out of such other soil erosion control measures as may be described elsewhere herein, or asked by County Engineer or SCS District.

All soil erosion and sediment control facilities shall be constructed in conformance with the New Jersey Standards therefore.

#### 158.03.02 SESC Measures

THIS SECTION IS REPLACED WITH THE FOLLOWING:

**8. Inlet Filters.** Provide Type 1 and Type 2 inlet filters as follows:

- a. Type 1. For a new inlet structure without a casting, mold welded steel wire fabric around the inlet walls. Extend the welded steel wire a minimum of 6 inches down each side of the structure. Secure geotextile to the welded wire fabric. Place No. 2 coarse aggregate against the inlet structure to hold the inlet filter in place.

For an inlet structure with a casting and exposed exterior walls, place geotextile under the casting and extend it a minimum of 6 inches below the top of the exposed walls. Place No. 2 coarse aggregate around the drain hole opening.

For an existing inlet structure without exposed exterior walls, place geotextile under the grate and extend the geotextile for a minimum of 6 inches beyond the grate.

For an inlet with a curb piece and without exposed exterior walls, ensure that the opening in the curb piece has a height of 2 inches. If the opening is greater than 2 inches, achieve the 2 inch opening size by wrapping the geotextile around an appropriately sized piece of lumber. Place the lumber against the vertical opening.

- b. Type 2. Remove the inlet grate and place the inlet filter in the opening, holding out approximately 6 inches of the filter outside the frame. Replace the inlet grate to hold the filter in place. Empty the filter according to the manufacturer's recommendations. When removing the filter, ensure that sediment does not enter into the drainage system. Clean out the filter, dispose of the sediment as specified in 202.03.07.B, rinse and return the filter to its original shape, and replace the filter inside the inlet

## **20. INLET SEDIMENT CONTROL**

Inlet sediment control devices shall be constructed in accordance with the details in the Plans, and shall be placed where indicated in the Plans. They shall be securely fastened in place, and shall be maintained in good working order by the Contractor as long as they are needed.

A sediment control device no longer needed at one location may be reset at another, provided that it is in good condition and functions properly. All sediment control facilities shall be ultimately removed from the Project site, by the Contractor.

## **21. ROADWAY CLEANING**

The roads are to be kept clean and dust free. All streets are to be swept daily with a power broom with a water tank or with a water wagon.

## **22. MAINTENANCE OF ADJACENT ROADWAYS**

The Contractor shall be responsible for maintaining the cleanliness and condition of all roadways over which construction traffic travels. All adjacent roadways and areas shall be kept clean of construction debris, excess materials and trash generated during construction operations.

## **158.04 MEASUREMENT AND PAYMENT**

The list of pay items is deleted and the following is added:

Separate payment will not be made for temporary soil erosion and sediment control and water quality will not be made but will be included in the various items in the proposal. No separate payment shall be made for Soil Erosion Control unless otherwise requested in the Form of Proposal.

Unless otherwise specifically provided for in this proposal no separate or additional payment will be made for Soil Erosion Control. The Contractor is responsible for complying with Applicable Soil Erosion Control measures.

## SECTION 159 – TRAFFIC CONTROL

### 159.01 DESCRIPTION

THE FOLLOWING IS ADDED TO THIS SUBSECTION:

The provisions of the NJSSRBC 2019 shall govern. Maintenance and protection of traffic shall include furnishing, setting, maintaining, removal and all else pertaining to traffic control devices.

### 159.03 PROCEDURE

THE FOLLOWING IS ADDED TO THIS SUBSECTION:

#### 159.03.10 Maintenance of Traffic Control

Through vehicular traffic shall be maintained at all times on the County roadway.

During work hours, access for local vehicular, emergency vehicular and pedestrian traffic shall be maintained at all times through the project limits. During non-work hours, vehicular traffic shall be maintained in both directions through the project limits.

Traffic control signage including pedestrian directional signage shall be provided and maintained to ensure a handicap accessible pedestrian route is provided at all times during construction.

The contractor shall maintain ingress and egress to all properties along the project during and after working hours, including weekends and holidays.

If during the course of construction, the Contractor finds that a particular access to private property must be interrupted than he shall arrange an alternate access to the property acceptable to the property owner.

Contractor must coordinate all traffic control with the municipal police department. A Traffic Control Plan must be approved by both Camden County and the Municipal Police Department one full week (7 calendar days) prior to start of construction that requires traffic control. Cost for such plan and aforementioned should be included in various pay items.

- The Contractor shall provide a detailed Traffic Control Plan for the maintenance and protection of traffic.
- Traffic control plans, traffic control procedures and devices shall conform to the Manual on Uniform Traffic Control Devices (most current addition).
- During actual construction operations at least one lane shall be maintained open to vehicular traffic.
- A Traffic Control Plan should be provided for alternating traffic patterns.
- If the construction methods or unforeseen conditions require that the roadway be closed to traffic due protect the health, safety and welfare of the public, a detailed Traffic Control Plan shall be provided for review and approval by the County Engineer and Municipal Police department. The County roadway will not be closed to traffic for the convenience of the contractor.
- When it is determined that a traffic detour is necessary for public safety, the Contractor shall establish a route with the approval of the local authorities having jurisdiction. The Contractor shall make all necessary arrangements with such authorities regarding the establishment, regulation and direction of traffic thereon, and shall furnish and erect, adequate directional and detour signs, acceptable to the local authorities.

- When it is determined that a traffic detour is necessary for public safety, the Contractor must provide emergency vehicular access at all times.

No excavation shall remain open overnight.

Work hours under County Roads with standard traffic conditions will be 7:00 am to 3:30 pm. The Camden County Engineer may reduce the work hours to after 9:00 AM and before 4:00 PM for a County Road that is a heavily traveled arterial roadway, a collector roadway, a roadway that provides access to Federal or State Highway(s) or a roadway that provides direct access to a transportation center such as a train station.

Traffic control devices need not be new but shall be in good condition. Traffic control procedures and devices shall conform to the Manual on Uniform Traffic Control Devices (most current addition).

All flag persons used for traffic control are to be supplied by the Contractor **NOT** the County.

The length of concrete curing period shall be determined by the Inspector or Supervisor depending on conditions. The Contractor shall provide sufficient barricades and watchmen to assure proper curing by detouring traffic. Any steel plate(s) required to keep roadway open per the specifications during project's construction phase must be installed per the approval of the County Engineer. No additional payment will be made to perform such installation, maintenance, mobilization, re-mobilization and protection of such steel plate(s) or any other means and methods used to maintain roadway open to traffic during construction per the specifications.

On any section opened to traffic, whether provided for in the Contract Documents or opened as directed, any damage to the roadway due to the Contractor's operations shall be repaired at no cost to the County.

**Maintenance will include temporary repairs to all potholes and utility openings other than temporary utility patch, within the project limits during the project duration.** Locations requiring maintenance shall be determined by the inspector or constructor. This maintenance shall include temporary repairs to potholes and utility openings within the project limits. Utility openings that are temporary utility patches under County road opening permits shall be the responsibility of the utility company. This maintenance shall consist of continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway is kept in satisfactory condition at all times. Locations requiring maintenance shall be determined by the inspector, construction manager or representative for the Camden County Engineer.

The Contractor shall not be responsible for removal of ice or snow from sections of roadways opened to traffic or for damage to the Project caused by the operation of snow plows or other snow removal or de-icing operations carried on by others under the supervision or direction of the Department.

All traffic control equipment shall conform to the Manual on Uniform Traffic Control Devices, latest edition. No Payment will be made for maintenance and protection of traffic which shall include all signs, barriers, flashers and personnel necessary to provide proper traffic control as directed by the Engineer, local authorities and Specifications, all labor, equipment and all other work in connection therewith and incidental thereto. Other than specific items listed in Section 159.04, the costs for maintenance and protection of traffic shall be included in the prices bid for the various items scheduled in the Proposal.

Police Uniformed Law Enforcement Officers are NOT required for this project.

## **159.04 MEASUREMENT AND PAYMENT**

THIS SECTION IS REPLACED WITH THE FOLLOWING:

Separate payment will not be made for maintenance and traffic control, but shall be included in the various items of the proposal. It is not anticipated that any Uniformed Law Enforcement Officers will be required.

## **SECTION 161 FINAL CLEAN UP**

### **161.01 DESCRIPTION**

THE FOLLOWING IS ADDED TO THIS SUBSECTION:

Final Cleanup with demobilization shall consist of the complete removal of all personnel, equipment, supplies, materials and incidentals from the project site and storage areas. A final cleanup of all areas disturbed or used as part of the project by the Contractor and/or Subcontractor shall be performed as part of the demobilization. This final clean up should include the removal of all rubbish, excess materials, temporary structures and equipment. All work areas shall be left in an acceptable condition and is subject to the Engineer's inspection and approval.

No specific payment will be made for Final Cleanup with demobilization. The cost thereof shall be included in the prices bid for the various items scheduled in the Proposal.

## SECTION 162 ALLOWANCE

### 162.01 DESCRIPTION

The Contractor shall make an allowance in his bid for any modifications or additions associated with construction of the project including any incidental or additional material, services or appurtenances not specifically described in the specifications but required to satisfactorily complete the project. All work must be ordered by the Engineer to qualify for payment. This item is intended to be utilized to compensate the Contractor for any unknown items of work.

### 161.04 MEASUREMENT AND PAYMENT

Item  
ALLOWANCE

Pay Unit  
ALLOWANCE

The Contractor will be paid from the allowance based on a mutually agreeable price between the Contractor and the Owner/Engineer prior to commencing work not specified. To qualify for payment, work must be ordered by the Owner or Engineer in writing.

The Contractor shall allow \$50,000.00 for this item to cover the work under item "ALLOWANCE". Nothing herein shall constitute a guarantee that the Contractor is entitled to payment of any portion of the allowance. If no work is done until this item, the full amount of \$50,000.00 shall not be paid by the Owner to the Contractor.

## **DIVISION 200 - EARTHWORK**

### **SECTION 201 - CLEARING SITE**

#### **201.04 MEASUREMENT AND PAYMENT**

The following is added:

Payment for the item “clearing site” in excess of \$17,500 will not be made until completion of the project.



## SECTION 202 – EXCAVATION

### 202.04 MEASUREMENT AND PAYMENT

The following is added:

This work shall also include earthwork, being defined as stripping, grading, filling, cutting and the general movement of topsoil and/or earth to provide the final grades as shown on the contract drawings.

### 202.04 MEASUREMENT AND PAYMENT

The list of pay items is deleted and the following is added:

<u>Item</u>	<u>Pay Unit</u>
EARTHWORK	LUMP SUM

The following is added:

Separate payment will not be made for soil aggregate fill material and borrow topsoil of any kind associated with the pay item "Earthwork," but the cost shall be included in the price bid for earthwork.

**DIVISION 600 - MISCELLANEOUS CONSTRUCTION**

**SECTION 601 - PIPE**

**601.04 MEASUREMENT AND PAYMENT**

The following items are added:

<i>Item</i>	<i>Pay Unit</i>
12" HIGH DENSITY POLYETHYLENE PIPE	LINEAR FOOT

**SECTION 602 – DRAINAGE STRUCTURES**

**602.04 MEASUREMENT AND PAYMENT**

The following item is added:

<i>Item</i>	<i>Pay Unit</i>
INLET, MODIFIED, TYPE A	UNIT

## **SECTION 606 - SIDEWALKS, DRIVEWAYS AND ISLANDS**

### **606.01 DESCRIPTION**

The following is added:

This work shall also include the construction of a Portland cement concrete surfacing with an exposed aggregate finish. All work shall be in accordance with NJDOT Standard Specifications and as contained herein, and as shown on the plans.

### **606.02 MATERIALS**

The following is added:

Concrete shall be Class B.

Coarse aggregate shall be 100% Median Sandstone meeting the requirement of subsection 901.10, No. 1 crushed stone. Samples must be submitted to the Engineer for inspection and written approval prior to construction.

Retarding agent shall comply with requirements of 40 CFR 59, Subpart D. Documentation must be submitted to the Engineer for approval, prior to construction.

Sealer material on all exposed aggregate surfaces shall be a transparent, non-glossy 100% acrylic (methyl methacrylate) water based emulsion to protect and waterproof the slabs. Material shall be unaffected by atmospheric contaminants from car or industrial exhaust, fuels and roadway salts and meet the following ASTM standards:

1. D-1653 – Maximum Moisture Vapor Transmission of 0.550 mgm/clll21mm/24 hours.
2. C-291 – 60 Cycles without deterioration.
3. E-239 – 800 Hour Exposure without change in appearance.

### **606.03 CONSTRUCTION**

The following is added:

#### **606.03.04 Exposed Aggregate Concrete Sidewalk**

The exposed aggregate concrete surfacing shall be constructed by a method employing a retarding agent. The concrete shall be poured in one course to the full depth shown on the plans, screeded and finished. The concrete shall not be vibrated. Curing procedures shall begin immediately upon finishing the surface. Within one hour after the concrete is placed, the retarding agent shall be sprayed on the concrete surface according to the manufacturer's recommendation. The surfacing shall be wet-cured using a minimum 6 mil black plastic cover for 12–16 hours, then the aggregate shall be exposed by washing off the cement paste using a high pressure water hose. Openings in planters shall be closed off to prevent any wash from getting into the planters. The finished surface shall be completely covered with aggregate with a uniform appearance, as determined by the Engineer. The aggregate exposed shall have a 3/16" depth of exposure. The depth of exposure shall be measured by laying a straight edge across the plane of the surface and measuring down to the concrete matrix. The concrete surface shall be scored at intervals as indicated on the plans. The method of scoring along with the width and depth of score lines shall be as indicated on the plans. The surfacing shall then be wet-cured for a minimum of three (3) days, then air dried for thirty (30) days. The concrete shall

then receive two (2) applications of an approved acrylic sealer in accordance with the manufacturers' recommendations.

One sample segment of exposed aggregate concrete sidewalk measuring 5' x 5' (25 square feet) shall be constructed in a portion of the flatwork area to determine the suitability of the appearance. If the sample segment is suitable to the Engineer, the chosen sample shall become part of the finished flatwork. If the initial sample section is unsatisfactory, it shall be removed and a new sample segment shall be constructed. There will be no limitation of the number of sample segments required before approval is given. Subsequent segments shall be accepted based on conformance to the approved, chosen sample segment.

A premolded resilient joint filler shall be installed at all joints between surfacing and curb, pavement, building, etc.

**606.04 MEASUREMENT AND PAYMENT**

The following pay items are added:

<i>Item</i>	<i>Pay Unit</i>
CONCRETE PAD, REINFORCED, EXPOSED AGGREGATE, 6" THICK	SQUARE YARD
CONCRETE SIDEWALK, EXPOSED AGGREGATE, 4" THICK	SQUARE YARD

The following is added:

All labor and materials associated with the installation of the concrete pad reinforced, including but not limited to reinforcement and concrete, shall be included in the unit price bid for that particular item.

The following section is added:

**SECTION 613 – SITE APPURTENANCES**

613.01 DESCRIPTION

This work shall consist of labor, materials, and equipment necessary for the furnishing and installation of the toilet enclosure. This work shall include but not be limited to installation of the toilet enclosure and related anchoring hardware as shown on the plans and as specified herein.

The Contractor shall submit signed and sealed shop drawings and calculations to the Engineer for approval prior to ordering the structure.

613.02 MATERIALS

The following items, or approved equal, shall be installed:

<u>Item</u>	<u>Description</u>
Toilet Enclosure	10' x 20' Building Type RG20X10M-P4 as manufactured by Icon Shelter Systems, Inc., or approved equal.

613.03 CONSTRUCTION

The toilet enclosure shall be installed in the location as shown on the plans, and in accordance with the manufacturer's requirements. The Contractor shall be responsible for protection of the toilet enclosure until final acceptance by the Owner. All manufacturer guarantees shall be given to the Owner.

613.04 MEASUREMENT AND PAYMENT

All site appurtenances will be measured by the unit. The prices bid for the respective items shall include all labor, materials and equipment necessary for the furnishing and installation of the toilet enclosure. This includes, but is not limited to, all necessary excavation, installation of toilet enclosure, concrete footings, related anchoring hardware, fill, and all else necessary therefore and incidental thereto.

<u>Item</u>	<u>Pay Unit</u>
TOILET ENCLOSURE	UNIT

**DIVISION 650 - UTILITIES**

**SECTION 651 - WATER**

**651.04 MEASUREMENT AND PAYMENT**

The following items are added:

<i>Item</i>	<i>Pay Unit</i>
WATER LATERAL, 3/4" DIAMETER, COPPER, TYPE K	LINEAR FOOT

**DIVISION 800 – LANDSCAPING**

**SECTION 804 – TOPSOIL SPREADING**

**804.04 MEASUREMENT AND PAYMENT**

The following is added:

Separate payment will not be made for the stripping of topsoil. All costs shall be included in the price bid for TOPSOIL SPREADING, 5" THICK.



## **SECTION 811 - PLANTING**

### **811.04 MEASUREMENT AND PAYMENT**

The pay item Plant Establishment Period is deleted.

Separate payment will not be made for Plant Establishment Period, but the cost shall be included in the price bid for plantings of the various kinds and sizes. The Plant Establishment Period shall be two (2) years from the date of project completion.

## SECTION 917 – LANDSCAPING MATERIALS

### 9017.10 Topsoil.

The entire section is deleted and the following is added:

Topsoil shall be loamy sand, sandy loam, clay-loam, loam, silt loam, or other soil approved by the Engineer. It shall be natural, fertile soil capable of sustaining vigorous plant growth and shall be of a uniform quality, free from subsoil, slag, cinders, stones 1 inch or larger in any dimension, lumps of soil, sticks, roots, trash, or other extraneous, undesirable materials. Topsoil shall also be free of viable plants or plant parts of Bermuda grass, quackgrass, Johnson grass, nut sedge, poison ivy, Canada thistle, or similar material. The contractor shall have all topsoil tested by a reputable laboratory with resulting documentation submitted to the Engineer.

- A. If testing reveals that the topsoil does not conform to the requirements of this section, the contractor shall be responsible for adjusting the ph range and/or percent of organic matter by means of approved additives.
- B. Topsoil shall meet the following requirements:
1. ph range - 5.0 to 7.0.
  2. Organic matter - four (4) percent (loss on ignition).
  3. Soluble salts no higher than 500 parts per million.
  4. Sieve Analysis:

Sieve Size	Percent Passing
1"	100%
½"	97%
#10	60-80%
#40	40-60%
#60	40-60%
#100	10-30%
#200	10-20%

- C. When topsoil, stockpiled on site, is to be reused, soil debris to include roots, sods, stones, clay lumps, and other extraneous materials harmful to plant growth shall be removed prior to reuse.
- D. Materials stripped from the following sources shall not be considered suitable for use as topsoil:
1. Soils having less than 4.1 ph value.
  2. Chemically contaminated soils.
  3. Areas from which the original surface has been stripped and/or covered over such as borrow pits, open mines, demolition sites, dumps, and sanitary landfills.
  4. Wet excavation.

END OF SUPPLEMENTARY SPECIFICATIONS