LEGAT ARCHITECTS

Project Manual BIDDING

ARCHITECT'S PROJECT NUMBER 225057.00

# Moline – Coal Valley School District

# 2026 Facility Improvements

| | |
|---|---|
| **Butterworth Elementary School** | **4205 48th Street, Moline, IL 61265** |
| **Logan Elementary School** | **1602 25th Street, Moline, IL 61265** |
| **Moline High School** | **3600 Avenue of the Cities, Moline, IL 61265** |
| **Washington Elementary School** | **1550 41st Street, Moline, IL 61265** |

FOR THE

Board of Education

**Moline – Coal Valley School**
**1900 52nd Avenue**
**Moline, IL 61265**

**February 16, 2026**

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**SECTION 00 01 01**
**PROJECT TITLE PAGE**

**PROJECT MANUAL**

**FOR**

**2026 FACILITY IMPROVEMENTS**

**ARCHITECT'S PROJECT NUMBER: 225057.00.**

**MOLINE-COAL VALLEY SCHOOL DISTRICT #40**

**BUTTERWORTH ELEMENTARY SCHOOL:**
**4205 48TH STREET, MOLINE, IL 61265**

**LOGAN ELEMENTARY SCHOOL:**
**1602 25TH STREET, MOLINE, IL 61265**

**MOLINE HIGH SCHOOL:**
**3600 AVENUE OF THE CITIES, MOLINE, IL 61265**

**WASHINGTON ELEMENTARY SCHOOL:**
**1550 41ST STREET, MOLINE, IL 61265**

**DATE: 02-16-2026**

**PREPARED BY:**

**LEGAT ARCHITECTS, INC.**

**END OF SECTION 00 01 01**

**SECTION 00 01 02**
**PROJECT INFORMATION**

## PART 1 GENERAL

### 1.01 PROJECT IDENTIFICATION

A. Project Name: 2026 Facility Improvements, located at:
   1. Butterworth Elementary School: 4205 48th Street, Moline, IL 61265
   2. Logan Elementary School: 1602 25th Street, Moline, IL 61265
   3. Moline High School: 3600 Avenue of the Cities, Moline, IL 61265
   4. Washington Elementary School: 1550 41st Street, Moline, IL 61265

B. The Owner, hereinafter referred to as Owner: Moline-Coal Valley School District #40

### 1.02 NOTICE TO PROSPECTIVE BIDDERS

A. These documents constitute an Invitation to Bid to and request for qualifications from General Contractors for the construction of the project described below.

### 1.03 PROJECT DESCRIPTION

A. Summary Project Description:
   1. Butterworth Elementary School scope of work includes, but is not limited to, replacement of existing casework, chalkboards, markerboards, tackboards, basketball hoops, and gymnasium wall pads with new. Repainting throughout the school, including refinishing of the existing stage. Repainting the exterior soffit and doors. Installing new storefront systems at the main entry to provide a controlled entrance. Various other improvements as noted on the plans.
   2. Logan Elementary School scope of work includes, but is not limited to, replacement of existing casework, chalkboards, markerboards, tackboards, basketball hoops, and gymnasium wall pads with new. Repainting throughout the school, including refinishing of the existing stage. Repainting the exterior soffit and doors. Installing new storefront systems at the main entry to provide a controlled entrance.
   3. Washington Elementary School scope of work includes, but is not limited to, replacement of existing casework, chalkboards, markerboards, tackboards, basketball hoops, lockers, and gymnasium wall pads with new. Repainting throughout the school, including refinishing of the existing stage. Removing the existing gym floor and installing a new multi-purpose rubber floor. Installing new flooring at the main office. Various other improvements as noted on the plans.
   4. Moline High School scope of work includes, but is not limited to, the installation of new finishes to the vocational machine shop and cafeteria areas. Installation of a new overhead sectional door and new plumbing fixtures within the vocational shop. Installation of new storefront f

B. Contract Scope: Construction, demolition, and facility operations during occupancy.

C. Contract Terms: Lump sum (fixed price, stipulated sum).

### 1.04 PROJECT CONSULTANTS

A. The Architect, hereinafter referred to as Architect: Legat Architects.
   1. Address: 1515 5th Ave. Suite 108.
   2. City, State, Zip: Moline, IL, 61265.
   3. Phone/Fax: 309-517-5536.

### 1.05 PROCUREMENT TIMETABLE

A. Pre-Bid Briefing: Wednesday, February 18, 2026, at 3:00 PM prevailing time at Butterworth Elementary School, 4205 48th Street, Moline, IL 61265and will continue to Washington Elementary School, 1550 41st Street, Moline, IL 61265, Moline High School, 3600 Avenue of the Cities, Moline, IL 61265 and Logan Elementary School, 1602 25th Street, Moline, IL 61265 in sequential order.

B. Last Request for Substitution Due: 4 days prior to due date of bids.

C. Last Request for Information Due: 4 days prior to due date of bids.

D. Bid Due Date: 03-03-2026, before 2:30 PM local time.

E. Bid Opening: Same day, Immediately following bid period closing. local time.

F. Notice to Proceed: Tuesday, March 10, 2026.

G. Bids May Not Be Withdrawn Until: 60 days after due date.

H. Contract Time: Refer to Project Schedule..

I. Anticipated Construction Start: Not later than Monday, June 1, 2026.

J. Desired Substantial Completion Date: 07-31-2026.

K. Required Final Completion Date: 08-07-2026.
   1. Moline High School cafeteria scope to have a Final Completion Date no later than Friday, July 10, 2026

L. Final Completion date is critical due to requirements of Owner's operations.

M. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

**1.06 PROCUREMENT DOCUMENTS**

A. Availability of Documents: Complete sets of procurement documents may be obtained:
   1. Digitally from City Blue Technologies Public Planroom; www.cityblueplanroom.com.
   2. Hard copies of the bid documents are available for puchase at the Contractor's expense.
   3. From Owner at the Project Manager's address listed above.

B. Documents are on display at the offices of the Owner and Architect:
   1. Owner:
      a. 1900 52nd Avenue, Moline, IL 61265.
   2. Architect:
      a. 1515 5th Avenue, Suite 108, Moline, IL 61265.

**1.07 BID SECURITY**

A. Bids shall be accompanied by a security deposit as follows:
   1. Bid Bond of a sum no less than 10 percent of the Bid Amount on AIA A310 Bid Bond Form.
   2. Security made payable to Owner in an amount of 10 percent of proposer's maximum proposal price.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION 00 01 02**

**SECTION 00 11 13**
**ADVERTISEMENT FOR BIDS**

## ADVERTISEMENT FOR BIDS

### 1.01 BID INFORMATION

A. Sealed bids will be received by the Board of Education, Moline-Coal Valley School District No. 40, 1900 52nd Avenue, Moline, IL 61265, on Tuesday, March 3, 2026, at 2:30 PM prevailing time for the 2026 Facility Improvements at Butterworth Elementary School, Logan Elementary School, Moline High School and Washington Elementary School.

B. Lump sum bid proposals will be received for this project at the scheduled time of receipt of bids and will be publicly opened at that time.

C. A Pre-Bid Conference will be held on Wednesday, February 18, 2026, at 3:00 PM, starting at Butterworth Elementary School, 4205 48th Street, Moline, IL 61265 and will continue to the other facilities, Washington Elementary School, Moline High School, and Logan Elementary School. All Bidders are strongly encouraged to attend and sign-in at the meeting, which will also be attended by the Owner, and Architect. All bidders are also strongly encouraged to make a site visit prior to submitting their bid. Site visit must be pre-arranged with 48-hour notice.

D. Bid security in the form of a bid bond, certified check, or cash in an amount equal to 10 percent of the base bid amount shall be submitted with the bid. Should a bid bond be submitted, the bid bond shall be payable to the Board of Education, Moline-Coal Valley School District No. 40.

E. Bids shall be submitted on or before the specified closing time in an opaque, sealed envelope. Bids shall be clearly marked “2026 Facility Improvements.” Bids shall be addressed to Moline-Coal Valley School District No. 40, Attn: Vince Gallo, Business Office, 1900 52nd Avenue, Moline, IL 61265.

F. The Board of Education reserves the right to reject any or all bids or parts thereof, or waive any irregularities or informalities, and to make the award in the best interest of the District.

G. All bidders must comply with applicable Illinois law requiring the payment of prevailing wages by all contractors working on public works. Bidder must comply with the Illinois statutory requirements regarding labor, including Equal Employment Opportunity laws.

H. Digital bidding documents can be obtained from City Blue Technologies; www.citybluetechnologies.com. Hard copies of the bid documents are available for purchase at the Contractor's expense.

I. Board of Education: Moline-Coal Valley School District No. 40

**SECTION 00 21 13**
**INSTRUCTIONS TO BIDDERS**

## SUMMARY

### 1.01 PROJECT

A. Project: 2026 Facility Improvements.

B. Project Location(s):
   1. Butterworth Elementary School: 4205 48th Street, Moline, IL 61265
   2. Logan Elementary School: 1602 25th Street, Moline, IL 61265
   3. Washington Elementary School: 1550 41st Street, Moline, IL 61265
   4. Moline High School: 3600 Avenue of the Cities, Moline, IL 61265

C. Owner's Name: Moline-Coal Valley School District #40.
   1. Address: 1900 52nd Ave., Moline, IL 61265.

D. Architect's Name: Legat Architects, Inc.
   1. Address: 1515 5th Ave, Suite 108, Moline, IL 61265.

### 1.02 DOCUMENT INCLUDES

A. Invitation
   1. Bid Submission
   2. Intent

B. Bid Documents and Contract Documents

C. Site Assessment
   1. Prebid Conference

D. Bid Submission
   1. Submission Procedure
   2. Bid Ineligibility

E. Bid Enclosures/Requirements
   1. Bid Bond
   2. Section 00 41 00 - Bid Form including all signatures, initials, and notarizations.
   3. Experience Questionnaire
   4. Contractor's Finiancial Statement
   5. Non-Colllusion Affidavit
   6. Sex Offender Acknowledgement and Certification
   7. Additional Bid Information as required by the Owner.

F. Information to be submitted after bid. Can be submitted electronically.
   1. Section 00 43 36 - Proposed Subcontractors Form
   2. Section 00 43 73 - Proposed Schedule of Values From

G. Offer Acceptance/Rejection
   1. Duration of Offer
   2. Acceptance of Offer

### 1.03 RELATED DOCUMENTS

A. Document 01 10 00 - Summary.

B. Document 00 41 00 - Bid Form.

C. Document 00 43 36 - Proposed Subcontractors Form.

D. Document 00 43 23 - Alternates Form.

E. Document 00 43 25 - Substitution Request Form - During Procurement

**INVITATION**

**2.01 BID SUBMISSION**

A. Proposals to be entitled for consideration must be made in accordance with the following instructions:
   1. Submit one copy of bid on forms provided by the Architect with all blank spaces for bid prices filled in, in ink, or typewritten.
   2. Submit bid in an opaque, sealed envelope, addressed to: Moline-Coal Valley School District No. 40, Attn: Vince Gallo, Chief Financial Officer, Moline-Coal Valley School District, 1900 52nd Avenue, Moline, IL 61265.
      a. Mark the envelope SEALED FOR BID:
         1) Project Name.
         2) Bidder.
   3. Bids signed and under seal, executed, and dated will be received at the office of the Owner at 1900 52nd Ave., Moline, IL 61265 before 2:30 p.m. local prevailing time on 03-03-2026.
   4. Bids received after this time will not be accepted.
   5. Erasures or written memorandum on the Bid Form are prohibited. Include additional explanations, statements, or qualifications in a separate sheet attached to the Bid Form.
   6. The Bid shall appear only where called for in the Bid Form and shall not appear elsewhere in the proposal. Any Alternate prices (other than those set forth in the Bid Form) shall be listed on the Substitution Sheet.
   7. Fill in all blank spaces for the bid items with prices, or if not applicable, the words "No Bid."

B. Offers submitted after the above time will be returned to the bidder unopened.

C. The Owner reserves the right to reject any or all bids or parts therof at its sole discretion.

D. The Owner reserves the right to waive any or all irregularities or informalities.

E. Offers will be opened publicly immediately after the time for receipt of bids.

**2.02 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS**

A. Work of this proposed Contract comprises building construction, remodeling, renovation, and demolition, including general construction Work.

B. Project Location:
   1. Butterworth Elementary School: 4205 48th Street, Moline, IL 61265
   2. Logan Elementary School: 1602 25th Street, Moline, IL 61265
   3. Moline High School: 3600 Avenue of the Cities, Moline, IL 61265
   4. Washington Elementary School: 1550 41st Street, Moline, IL 61265

**BID DOCUMENTS AND CONTRACT DOCUMENTS**

**3.01 DEFINITIONS**

A. All definitions set forth in the General Conditions of the Contract for Construction as printed in Americal Institute of Architects, Document A201, General Conditions of the Contract for Construction - 2017 as modified, both contained herein are applicable to these instructions to Bidders.

B. Bid Documents: Contract Documents supplemented with Invitation To Bid, Instructions to Bidders, Information Available to Bidders, Bid Form Supplements To Bid Forms and Appendices identified.

C. Addenda are written or graphic instruments issued prior to the execution of the Contract which modify or interpret the bidding documents, including Drawings and Specifications, by additions, clarifications, or corrections. Addenda will become part of the Contract Documents when the Construction Contract is executed.
   1. Addenda will be issued by email, direct mail or United Parcel delivery. Bidders are to consider an email addendum as a binding modification to the contract documents.

2. It is the bidder's responsibility to ascertain from the Architect that they have recieved all addenda issued to the bidding documents prior to submitting their bids.

**3.02 AVAILABILITY**

A. Bid Documents may be obtained at the office of Architect Legat Architects, Inc., 1515 5th Avenue, Suite 108, Moline, IL 61265.

B. Digital bidding documents can be obtained from City Blue Technologies; www.citybluetechnologies.com. Hard copies of the bid documents are available for purchase at the Contractor's expense.

**3.03 EXAMINATION**

A. Bidders are responsible for examining all documents on file at the office of the Architect, Engineer, or Owner and are encouraged to make a site visit to examine the site to become familiar with and make allowance for any conditions which may affect the work. Contractors will not be given extra payments for conditions which can be determined by examining the site and documents.

B. Bid Documents may be viewed at the office of Architect Legat Architects, Inc., 1515 5th Avenue, Suite 108, Moline, IL 61265.

C. Bid Documents may be viewed at the office of Owner Moline-Coal Valley School District; 1900 52nd Avenue, Moline, IL 61265.

D. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.

E. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.

**3.04 INQUIRIES/ADDENDA**

A. Addenda may be issued during the bidding period. All Addenda become part of Contract Documents. Include resultant costs in the Bid Amount.

B. Verbal answers are not binding on any party.

**3.05 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS**

A. General Requirements for Substitution Requests:
   1. Project Manual establishes standards for products, assemblies, and systems.
   2. Submit requests only for elements for which substitution is specifically allowed in the Project Manual.

B. Substitution Request Time Restrictions:
   1. Where the Bid Documents stipulate a particular product, substitutions will be considered up to ____ days before receipt of bids.

C. Substitution Request Form:
   1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

D. Review and Acceptance of Request:
   1. Architect may approve the proposed substitution and will issue an Addendum to known bidders.

**SITE ASSESSMENT**

**4.01 SITE EXAMINATION**

A. Examine the project site before submitting a bid.

B. The bidder is required to contact Owner at the following address and phone number in order to arrange a date and time to visit the project site: Keith Karstens, Moline-Coal Valley School District No. 40, 1900 52nd Avenue, Moline, IL 61265, (309) 743-8650.

C. Bidders visiting schools must check in at the Main Office of each school and coordinate their inspections with School Visitor Policies.

**4.02 PREBID CONFERENCE**

A. A bidders conference has been scheduled for 3:00 p.m. on the 18th day of February starting at the location of Butterworth Elementary, 4205 48th St., Moline, IL 61265, and will continue over to Washington Elementary, 1550 41st St., Moline, IL 61265, Moline High School, 3600 Avenue of the Cities, Moline, IL 61265 and Logan Elementary, 1602 25th St., Moline, IL 61265 in sequential order.

B. All general contract bidders and suppliers are invited.

C. Representatives of the Architect will be in attendance.

D. Information relevant to the Bid Documents will be recorded in an Addendum, issued to Bid Document recipients.

**QUALIFICATIONS**

**5.01 EVIDENCE OF QUALIFICATIONS**

A. To demonstrate qualification for performing the Work of this Contract, bidders may be requested to submit written evidence of financial position, license to perform work in the State and prior successful experience on projects of similar size and scope. Accordingly, all Bidders must provide on their bid forms, references from at least five (5) public school district projects or other projects of similar size and scope, where the Bidders contract price equaled or exceeded the Bidder's bid for this project..

**5.02 BID WITHDRAWAL**

A. Any bidder shall withdraw their bid prior to the scheduled closing time for receiving bids. All bidders shall hold their Bids open for a period of sixty calendar days from the date of Bid Opening. The Owner and Bidders may agree to extend the period of irrevocability beyond the sixty-day period.

**BID SUBMISSION**

**6.01 SUBMISSION PROCEDURE**

A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.

B. Submit one copy of the executed offer on the Bid Forms provided, signed and sealed with the required security in a closed opaque envelope, clearly identified with bidder's name, project name and Owner's name on the outside.

C. Improperly completed information, irregularities in security deposit, may be cause not to open the Bid Form envelope and declare the bid invalid or informal.

**6.02 BID INELIGIBILITY**

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.

B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be declared unacceptable.

**BID ENCLOSURES/REQUIREMENTS**

**7.01 SECURITY DEPOSIT**

A. Bids shall be accompanied by a security deposit as follows:
   1. Bid Bond of a sum no less than 10 percent of the Bid Amount on AIA A310 Bid Bond Form.

B. Endorse the Bid Bond in the name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.

1. Make Bid Security payable to: Board of Education, Moline-Coal Valley School District No. 40.

C. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.

D. Include the cost of bid security in the Bid Amount.

E. After a bid has been accepted, all securities will be returned to the respective bidders .

F. If no contract is awarded, all security deposits will be returned.

**7.02 PERFORMANCE ASSURANCE**

A. Accepted Bidder: Provide a Performance and Labor and Material/Payment bond, per the terms of the General Conditions, as modified.
   1. Provide a 100 percent Performance Bond on AIA A312.
   2. Provide a 100 percent Payment Bond on AIA A312.
   3. Deliver bonds within 3 days after execution of the Contract.

B. Include the cost of performance assurance bonds in the Bid Amount and identify the cost when requested.

**7.03 BID FORM REQUIREMENTS**

A. Complete all requested information in the Bid Form and Appendices.

**7.04 ADDITIONAL BID INFORMATION**

A. Submit the following Supplements concurrent with bid submission:
   1. Document 00 43 25 - Substitution Request Form - During Procurement.
   2. Certification Regarding Criminal Background Investigations.
   3. Authorization for Criminal Background Investigation.
   4. Schedule A - Vendor Information Form.
   5. Schedule B - Civil Rights Certification of Compliance.
   6. Schedule C - Vendor Eligibility Certification Bidding & Contract Requirements.
   7. Schedule D - Certifications of Compliance with IL Drug Free Work Place Act.
   8. Schedule E - Bidding and Contract Requirements Non-Collusion Affidavit.
   9. Schedule F - Federal Tax ID and Disclosure.
   10. Schedule G - Certification Regarding Debarment.
   11. Schedule H - Notice to Applicants - Certification/Disclosure Requirements Related to Lobbying.
   12. Schedule I - Certificate of Liability Insurance.
   13. Instructions to Bidders Proposed Subcontractors and Material/Equipment Suppliers.

**7.05 POWER OF ATTORNEY**

A. Attorneys-in-Fact who sign bonds, Agreements or bids must file with each such documents a certified and effectively-dated copy of their Power of Attorney.

**7.06 EMPLOYMENT AND LABOR PROVISIONS**

A. In the employemnt and use of labor, the Contractor and his subcontractors shall conrom to the Illinois Statutory requirements regarding labor and wages. See Document 00 82 00 - Prevailing Wage Requirements.

B. Vendors/Contractors must conform to all federal, state, local and OSHA Regulations in effect during the term of the project.

**7.07 TIME OF COMPLETION**

A. If awarded the Contract, the bidder agrees to complete all Construction Work and achieve Substantial Completion and Final Completion of the following dates:
   1. Start of construction: Monday, June 1, 2026
   2. Substantial Completion: Friday, July 31, 2026
   3. Final Completion for the entire proejct is: Friday, August 7, 2026

**OFFER ACCEPTANCE/REJECTION**

**8.01 DURATION OF OFFER**

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

**8.02 ACCEPTANCE OF OFFER**

A. Owner reserves the right to accept or reject any or all offers.

B. After acceptance by Owner, Architect on behalf of Owner, will issue to the successful bidder, a written Bid Acceptance.

**END OF SECTION 00 21 13**

**SECTION 00 41 00**
**BID FORM**

**THE PROJECT AND THE PARTIES**

**2.01 FROM:**

_____

Firm Name of Bidder

**2.02 TO:**

**MOLINE-COAL VALLEY SCHOOL DISTRICT NO. 40. BOARD OF EDUCATION**

**1900 52ND AVENUE, MOLINE, IL 61265**

**ATTN: VINCE GALLO**

**2.03 BID:**

A. **Base Bid:** We as contractor having familiarized ourselves with local conditions affecting the work and with the proposed Contact Documents on file at the office of the Owner, hereby propose to perform everything required to be performed and to provide all of the labor, materials, necessary equipment and all utilities and transportation and services necessary to perform and complete in a workmanlike manner all work required to complete the proposed work indicated in the bidding documents for the construction of the 2026 Facility Improvements at 4 Schools project, all in accordance with the Drawings and Specifications prepared by the office of Legat Architects, Inc. including the following Addenda Numbers _____, _____, and _____ issued thereto for the sum of:

1. Base Bid for all work: _____
   ($_____)
   a. For accounting purposes, provide a per-school cost breakdown of the above listed bid.
      1) Butterworth Elemetnary School:_____
      ($_____)
      2) Logan Elemetnary School:_____
      ($_____)
      3) Moline High School D101 Room:
      _____
      ($_____)
      4) Moline High School Cafeteria Room:
      _____
      ($_____)
      5) Washington Elemetnary School:_____
      ($_____)
   b. The base bid consists of all Work specified and required by the proposed Contract Documents.

B. **Prevailing Wage Act:** The undersigned hereby states if awarded the Contract, the Bidder agrees to comply with the Illinois Prevailing Wage Act 820 ILCS Section 130/.0.01 including, but not limited to, the submission of Certified Transcripts of Payroll for all workers on a monthly basis to the Illinois Department of Labor and copied to the Owner. The Bidder further acknowledges that release of progress payments may be withheld if complete Certified Transcripts of Payroll are not submitted with applications for payment.

C. **Allowances:** The undersigned hereby states allowances specified in Document 01 21 00 - Allowances, and confirmed here in writing, are included in the Base Bid amount identified above.
   1. Allowances included in Base Bid: $_____.

D. **Bid Security:** Accompanying this proposal is a Bid Security made payable to the Board of Education, Moline-Coal Valley School District No. 40 which is agreed will be forfeited to the aforementioned as liquidated damages if the undersigned fails to execute the standard form of Owner/Contractor Agreement (AIA Document A101, 2017 Edition, as modified), which is included herein for reference, and furnish evidence of their ability to become bonded and provide insurance coverage, as specified, within fifteen (15) business days after receipt of the Agreement by the undersigned.

E. **Certification of Compliance:** In signing and submitting this Bid, the Bidder certifies that all materials and construction to be provided are as indicated in the proposed Contract Documents.

F. **Time of Completion:** The undersigned hereby states if awarded the Contract, the Bidder agrees to complete all work in accordance with the contract documents and achieve Substantial Completion as follows: _____.
   1. Start Date: Monday, June 1, 2026
   2. Substantial Completion: Friday, 07-31-2026
   3. Final Completion: Friday, 08-07-2026.
   4. Liquidated Damages: Liquidated damages for the project shall be assessed at $2,000.00 per day if substantial completion is not achieved by the date noted above for the Moline High School Cafeteria project. Refer to the AIA A101-2017 for additional information regarding Liquidated Damages.
   5. Refer to Document 01 10 00 - Summary for additional requirements which establishes intermediate construction milestone dates which may affect the construction sequence and/or construction schedule.

G. On the lines below, provide five (5) references from past projects of comparable size and scope to this project. Include the following information for each: Client name, address, brief project description and contact information.
   1. _____
      _____
   2. _____
      _____
   3. _____
      _____
   4. _____
      _____
   5. _____
      _____

**2.04 BIDDER**

A. _____
   Firm Name

B. _____
   Firm Official Address (Street Address)

C. _____
   Firm Official Address (City, State, Zip Code)

D. _____
   Firm Telephone Number

E. _____
   Firm Website

F. _____

Name of Bidder (Printed Name of Authorized Agent of Contractor)

G. _____

Signature of Bidder (Signed Name of Authorized Agent of Contractor)

H. _____

Email Address of Bidder

I. Where the Bidder is a corporation, add Attest:

1. _____
(Secretary Signature and Date)

J. CERTIFIED OR CASHIERS CHECK, BID BOND, OR BANK DRAFT ENCLOSED IN THE FOLLOWING AMOUNT:

**END OF SECTION 00 41 00**

**SECTION 00 43 25**
**PROPOSED SUBSTITUTIONS**

**PROPOSED SUBSTITUTIONS**

**2.01 SUBSTITUTION INFORMATION**

A. Project: 2025 Facility Improvements at 4 Schools for Moline-Coal Valley School District 40.

B. _____ Contractor,

(Firm Name of Bidder)

C. All bids shall be based upon the provisions of the proposed Contract Documents and not upon substitutions proposed herein.

D. Owner reserves the right to accept or reject all such substitutions at its sole discretion and in the best interest of Moline-Coal Valley School District 40.

E. Bidders desiring to make substitutions for "proprietary brands" specified shall identify the brand, make, and model number of the specified product together with the brand, make, and model number of the product being proposed as a subtitution and the dollar amount to be added or deducted from the base bid if the proposed substitution is accepted.

F. Complete descriptions and technical data shall accompany all proposed substitutions and be attached herein.

G. Manufacturer's names and materials approved by the Architect during the bidding period but not shown in addenda shall be listed below if said materials are to be considered.

**2.02 PROPOSED SUBSTITUTION 1:**

A. _____

Product Specified

B. _____

Proposed Substitution

C. $_____

Amount to be ADDED or DEDUCTED

**2.03 CERTIFICATION**

A. _____

Name of Bidder (Printed Name of Authorized Agent of Contractor)

B. _____

Signature of Bidder (Signed Name of Authorized Agent of Contractor)

C. _____

Date

**END OF SECTION 00 43 25**

**SECTION 00 43 36**
**PROPOSED SUBCONTRACTORS FORM**

**PARTICULARS**

**1.01 HEREWITH IS THE LIST OF SUBCONTRACTORS REFERENCED IN THE BID SUBMITTED BY:**

**1.02 (BIDDER) _____**

**1.03 TO (OWNER ): MOLINE-COAL VALLEY SCHOOL DISTRICT #40**

**1.04 DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.**

**1.05 THE FOLLOWING WORK WILL BE PERFORMED (OR PROVIDED) BY SUBCONTRACTORS AND COORDINATED BY US:**

**LIST OF SUBCONTRACTORS**

**NOTE WORK PERFORMED - SUBCONTRACTOR NAME**

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. Provide additional pages if needed

**LIST OF SUPPLIERS**

**NOTE MATERIAL SUPPLIED - SUPPLIER NAME**

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. Provide additional pages if needed

**END OF SECTION 00 43 36**

**SECTION 00 45 20**
**CERTIFICATE REGARDING CRIMINAL BACKGROUND INVESTIGATIONS**

## CERTIFICATION REGARDING CRIMINAL BACKGROUND INVESTIGATIONS

### 2.01 INFORMATION

A. Project: 2025 Facility Improvements at 4 Schools for Moline-Coal Valley School District 40

B. _____, Contractor,

(Firm name of Bidder)

hereby represents, warrants, and certifies that no officer or director thereof has any knowledge that any employee thereof has been convicted of committing or attempting to commit "Criminal Code of 1961," 720 ILCS, Sections 5/11-6 (Indecent solicitation of a child), 5/11-9 (Public indecency), 5/11-14 (Prostitution), 5/11-15 (Soliciting for a prostitute), 5/11-15.1 (Soliciting for a juvenile prostitute), 5/11-19 (Pimping), 5/11-19.1 (Juvenile pimping), 5/11-19.2 (Exploitation of a child), 5/11-20 (Obscenity), 5/11-20.1 (Sexual assault), 5/12-14 (Aggravated criminal sexual assault), 5/12-15 (Criminal sexual abuse), and 5/12-16 (Aggravated criminal sexual abuse), and/or those offenses defined in the "Cannabis Control Act," 720 ILCS, 550/l et. seq. (except the "Illinois Controlled Substances Act," 720 ILCS 570/100 et. seq.) and/or any offense committed or attempted in any other state or against the laws of the United States, which if committed or attempted in this State, would have been punishable as one or more of the foregoing offenses. Contractor further agrees that it shall not employ any person who have or may have direct, daily contact with the pupils of any school in the district, and for whom a criminal background investigation has not been conducted pursuant hereto, and further represents and agrees that all applicants for any such employment shall furnish with their applications the attached written "Authorization for Criminal Background Information" form authorizing the Board of Education to request a criminal background investigation of said applicant pursuant to Section 5/10-21.9 of the School Code of Illinois and to receive criminal history record information pursuant thereto to determine if the applicant has been convicted of committing or attempting to commit any of the criminal or drug offenses enumerated above. Contractor further agrees to submit with said authorization payment for any costs and expenses associated with the criminal background investigation Contractor further represents, warrants, and certifies that no applicant for employment with respect to whom the criminal investigation reveals any conviction for committing and/or attempting to commit any of the above enumerated offenses, shall be employed thereby in any position that involves or may involve contact with the students of the school district. This certification is executed on the date hereinafter indicated by the designated contractor by its duly authorized officer.

C. Refer to Document 00 72 00 - General Conditions for additional information.

### 2.02 CONTRACTOR

A. _____

Name of Bidder (Printed Name of Authorized Agent of Contractor)

B. _____

Signature of Bidder (Signed Name of Authorized Agent of Contractor)

C. _____

Date

**END OF SECTION**
**00 45 20**

**SECTION 00 45 30**
**AUTHORIZATION FOR CRIMINAL BACKGROUND INVESTIGATION**

## AUTHORIZATION FOR CRIMINAL BACKGROUND INVESTIGATION

### 2.01 CERTIFICATION

A. Project: 2025 Facility Improvements at 4 Schools for Moline-Coal Valley School District 40

B. _____, Contractor,

(Firm Name of Bidder)

C. The undersigned hereby authorizes the Board of Education, of Moline School District No. 40, Rock Island County, Illinois to request a criminal background investigation from the Illinois State Police, pursuant to Section 5/1--21.9 of the School Code of Illinois, 105 ILCS 5/10-21.9 and to receive criminal history record information pursuant thereto.

D. _____

Name of Employee or Applicant (Printed Name of Employee or Applicant)

E. _____

Signature of Employee or Applicant (Signature of Employee or Applicant)

F. _____

Name of Bidder (Printed Name of Authorized Agent of Contractor/Employer)

G. _____

Signature of Bidder (Signed Name of Authorized Agent of Contractor/Employer)

H. _____

Date

**NOTE:**

**SIGNATURE ON THIS FORM NOT REQUIRED FOR SUBMITTAL WITH BID.**
**THIS FORM IS TO BE SUBMITTED IF REQUESTED BY THE OWNER.**
**REFER TO DOCUMENT 00 45 20.**

**END OF SECTION 00 45 30**

**Assurance Schedule A**
**Vendor Information Form**

# *VENDOR INFORMATION FORM*

Name of Company: _____

Tax Payer ID #: _____ FCC/USAC "SPIN" Number:_____

Address: _____ Date Business Began:_____

_____

Telephone No: _____ Years at Location:_____

List of contact information for all officers, directors, and principals:

Name: _____
Title: _____
Address: _____
Telephone No: _____
Relationship: _____

Description of services provided:

Description of facilities/resources:

Description of staff (no./type/qualifications, etc.):

Brief history of company:

Client reference list of major customers and projects (include address and telephone number):

Verified by: _____
Date Verified: _____

**Assurance Schedule B**
**Civil Rights Certification of Compliance**

***CERTIFICATE OF COMPLIANCE***
***WITH ILLINOIS HUMAN RIGHTS ACT***

All successful contractors must comply with the provisions of the Illinois Human Rights Act (ACT) dealing with equal employment opportunities (Section 2-105, 775 ILCS 5/2-105) including equality of employment opportunity and the regulations of the Department of Human Rights of the State of Illinois and also must provide for the adoption and implementation of written Sexual Harassment Policies. The contract with the successful bidder will provide for this requirement. The statutory provisions require that the written Sexual Harassment policy included at a minimum the following information: (i) the illegality of sexual harassment; (ii) the definition of sexual harassment under Illinois law; (iii) a description of sexual harassment, utilizing examples; (iv) a vendor's internal complaint process including penalty; (v) the legal recourse, investigative and complaint process available through the Department of Human Rights Commission; (vi) directions on how to contact the Department of Commission; and (vii) protection against retaliation as provided by Section 6-101 of the Illinois Human Rights Act.

Firm Name_____

Address_____

Signature of Officer

_____

Title

_____

Subscribed and sworn to before me
this _____ day of _____, 20___.

Notary Public

_____

**Assurance Schedule C**
**Vendor Eligibility Certification**

***BIDDING AND CONTRACT REQUIREMENTS***
***Vendor Eligibility Certification***

Public Act 85-1295 (Illinois Revised Status, 1987, Ch 38, art 33E) requires that all contractors bidding for public agencies in the State of Illinois certify that they are not barred from bidding on public contracts for bid-rigging or bid rotation.

The following certifications must be signed and submitted with bidder's bid proposal. *FAILURE TO DO SO WILL RESULT IN DISQUALIFICATION OF THE BIDDER*.

_____. As part of its bid on contract for
(*Name of Contractor)*

_____. For Moline School
(*Name of Bid Package)*

District No. 40 hereby certifies that said contractor is not barred from bidding on the aforementioned contract as a result of a violation of either Section 33E-3 or 33E-4 of Article 33E of Chapter 38 of the Illinois Revised Statutes.

Firm Name: _____

By: _____

Title: _____

Subscribed and sworn to before me
this _____ day of _____, 20___.

Notary Public

_____

Verified by: _____
Date Verified: _____

**Assurance Schedule D**
**Drug Free WorkPlace**

***CERTIFICATIONS OF COMPLIANCE WITH ILLINOIS DRUG FREE WORKPLACE ACT***

The undersigned, having 25 or more employees, does hereby certify pursuant to section 3 of the Illinois Drug-Free Workplace Act (30 ILCS 580/3) that it shall provide a drug-free workplace for all employees engaged in the performance of work under the contract by complying with the requirements of the Illinois Drug-Free Workplace Act and, further certifies, that it is not ineligible for award of this contract by reason of debarment for violation of the Illinois Drug-Free Workplace Act.

_____ _____

Name of bidder (Please Print) Submitted by (Signature)

_____

Title

**Assurance Schedule E**
**Non-Collusion Affidavit**

***BIDDING AND CONTRACT REQUIREMENTS***
*Non-Collusion Affidavit*

*AFFIDAVIT: "I, (we) hereby certify and affirm that my (our) proposal was prepared independently for this bid package and that it contains no fees or amounts other than for the legitimate execution of this work as specified and that it includes no understanding or agreements in restraint of trade. I further certify that I (we) am not barred from bidding on the contract as a result of a conviction for either bid-rigging or bid rotating under Article 33E of the Criminal Code of 1961."*

The following certification must be signed and submitted with bidder's proposal. *FAILURE TO DO SO WILL RESULT IN DISQUALIFICATION OF THE BIDDER.*

**(If an individual)**
Signature of Proposer:_____
*(Seal)* *(Signature required)*

Business Address: _____

**(If a Partnership)**
Firm Name: _____
*(Seal)*
By _ _____
*(Signature required)*

Business Address: _____
(of all Partners of the Firm)

**(If a Corporation)**
Corporate Name: _____

By _____
*(Signature required)*

Corporate Address: _____

*(CORPORATE SEAL)*
*Names of Officers:* (President): _____

(Secretary): _____

(Treasurer): _____

Attest: (Secretary): _____

**Assurance Schedule F**
**Federal Tax ID and Disclosure**

Under penalties of perjury, I certify that _____is my correct Federal Taxpayer Identification Number. I am doing business as a (please check one):

_____Individual

_____Sole Proprietorship

_____Partnership

_____Corporation

_____Governmental Entity

_____Not-for-profit Corporation

_____ _____
Signature Date

Return this certification to:

Moline-Coal Valley CUSD 40
Attention: Business Office
1619 11th Avenue
Moline, Illinois 61265

# Assurance Schedule G
# Certification Regarding Debarment

## Instructions for Certification

1. By signing and submitting this Certification, the prospective lower tier participant is providing the certifications set out herein.
2. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal government, the department or agency with which this transaction originated may pursue all available remedies, including suspension and/or debarment.
3. Except for transactions authorized under paragraph 3 above, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal government, the department or agency with which this transaction originated may pursue all available remedies, including suspension and/or debarment.
4. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used herein, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549 and Executive Order 12689. You may contact the person to which this Certification is submitted for assistance in obtaining a copy of those regulations.
5. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier Covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the "GSA Excluded Parties List System" at http://epls.arnet.gov/.
6. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required herein. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

## Certification Regarding Debarment, Suspension, Ineligibility, and Voluntary Exclusion Lower Tier Covered Transactions

This certification is required by the regulations implementing Executive Orders 12549 and 12689, Debarment and Suspension, 7 CFR 3017 Subpart C Responsibilities of Participants Regarding Transactions. The regulations were published as Part IV of the January 30, 1989 Federal Register (pages 4722-4733) and Part II of the November 26, 2003 Federal Register (pages 66533-66646). Copies of the regulations may be obtained by contacting the Illinois State Board of Education.

**BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS BELOW.**

**CERTIFICATION**

The prospective lower tier participant certifies, by submission of this Certification, that:
(1) Neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency;
(2) It will provide immediate written notice to whom this Certification is submitted if at any time the prospective lower tier participant learns its certification was erroneous when submitted or has become erroneous by reason of changed circumstances;
(3) It shall not knowingly enter any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated;
(4) It will include the clause titled Certification Regarding Debarment, Suspension, Ineligibility, and Voluntary Exclusion—Lower Tier Covered Transactions, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions;
(5) The certifications herein are a material representation of fact upon which reliance was placed when this transaction was entered into; and
(6) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this Certification.

*Organization Name:* _____

*Name Authorized Representative:* _____

*Title of Authorized Representative:* _____

*Signature:* _____

*Signature Date:* _____

**Assurance Schedule H**
**Notification of Lobbying Activity**

## NOTICE TO APPLICANTS – CERTIFICATION/DISCLOSURE REQUIREMENTS RELATED TO LOBBYING

---

Section 319 of Public Law 101-121 (31 U.S.C.), signed into law on October 23, 1989, imposes new prohibitions and requirements for disclosure and certification related to lobbying on recipients of Federal contracts, grants, cooperative agreements, and loans. Certain provisions of the law also apply to Federal commitments for loan guarantees and insurance; however, it provides exemptions for Indian tribes and tribal organizations.

Effective December 23, 1989, current and prospective recipients (and their subtier contractors and/or subgrantees) will be prohibited from using Federal funds, other than profits from a Federal contract, for lobbying Congress or any Federal agency in connection with the award of a particular contract, grant, cooperative agreement or loan. In addition, for each award action in excess of $100,000 (or $150,000 for loans) on or after December 23, 1989, the law requires recipients and their subtier contractors and/or subgrantees to: (1) certify that they have neither used nor will use any appropriated funds for payment to lobbyists; (2) disclose the name, address, payment details, and purpose of any agreements with lobbyists whom recipients or their subtier contractors or subgrantees will pay with profits or **nonappropriated** funds on or after December 23, 1989; and (3) file quarterly updates about the use of lobbyists if materials changes occur in their use. The law establishes civil penalties for noncompliance.

If you are a current recipient of funding or have an application, proposal, or bid pending as of December 23, 1989, the law will have the following immediate consequences for you:

- You are prohibited from using appropriated funds (other than profits from Federal contracts) on or after December 23, 1989, for lobbying Congress or any Federal agency in connection with a particular contract, grant, cooperative agreement, or loan;

- you are required to execute the attached certification at the time of submission of an application or before any action in excess of $100,000 is awarded; and

- you will be required to complete the lobbying disclosure form if the disclosure requirements apply to you.

Regulations Implementing Section 319 of Public Law 101-121 have been published as an Interim Final Rule by the Office of Management and Budget as Part III of the February 26, 1990, **Federal Register** (pages 6736-6746).

(Continued on the next page)

**CERTIFICATION REGARDING LOBBYING – CONTRACTS, GRANTS, LOANS AND COOPERATIVE AGREEMENTS**

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal amendment, or modification of any Federal contract, grant, loan or cooperative agreement;

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions;

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Organization Name | Award Number or Project Name

Name and Title of Authorized Representative

Signature | Date

# Assurance Schedule I

ACORD®

## CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

**THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.**

**IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).**

| PRODUCER | CONTACT NAME: | |
|---|---|---|
| | PHONE (A/C, No, Ext): | FAX (A/C, No): |
| | E-MAIL ADDRESS: | |
| | INSURER(S) AFFORDING COVERAGE | NAIC # |
| INSURED | INSURER A : | |
| | INSURER B : | |
| | INSURER C : | |
| | INSURER D : | |
| | INSURER E : | |
| | INSURER F : | |

**COVERAGES** **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR | TYPE OF INSURANCE | ADDL INSD | SUBR WVD | POLICY NUMBER | POLICY EFF (MM/DD/YYYY) | POLICY EXP (MM/DD/YYYY) | LIMITS | |
|---|---|---|---|---|---|---|---|---|
| | **COMMERCIAL GENERAL LIABILITY** | | | | | | EACH OCCURRENCE | $ 1,000,000 |
| | [ ] CLAIMS-MADE [X] OCCUR | | | | | | DAMAGE TO RENTED PREMISES (Ea occurrence) | $ 50,000 |
| | | | | | | | MED EXP (Any one person) | $ 5,000 |
| | | | | | | | PERSONAL & ADV INJURY | $ 1,000,000 |
| | GEN'L AGGREGATE LIMIT APPLIES PER: | | | | | | GENERAL AGGREGATE | $ 1,000,000 |
| | [ ] POLICY [ ] PRO-JECT [ ] LOC | | | | | | PRODUCTS - COMP/OP AGG | $ 1,000,000 |
| | [ ] OTHER: | | | | | | | $ |
| | **AUTOMOBILE LIABILITY** | | | | | | COMBINED SINGLE LIMIT (Ea accident) | $ 1,000,000 |
| | [X] ANY AUTO | | | | | | BODILY INJURY (Per person) | $ |
| | [ ] OWNED AUTOS ONLY [ ] SCHEDULED AUTOS | | | | | | BODILY INJURY (Per accident) | $ |
| | [ ] HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY | | | | | | PROPERTY DAMAGE (Per accident) | $ |
| | | | | | | | | $ |
| | **UMBRELLA LIAB** [X] OCCUR | | | | | | EACH OCCURRENCE | $ 5,000,000 |
| | **EXCESS LIAB** [ ] CLAIMS-MADE | | | | | | AGGREGATE | $ 5,000,000 |
| | [ ] DED [X] RETENTION $ | | | | | | | $ |
| | **WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N | | | | | | [X] PER STATUTE [ ] OTH-ER | |
| | ANYPROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [ ] **(Mandatory in NH)** | N / A | | | | | E.L. EACH ACCIDENT | $ 100,000 |
| | If yes, describe under DESCRIPTION OF OPERATIONS below | | | | | | E.L. DISEASE - EA EMPLOYEE | $ 100,000 |
| | | | | | | | E.L. DISEASE - POLICY LIMIT | $ 500,000 |
| | | | | | | | | |

**DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)**

Certificate Holder named as Additional Insured, as their interest may appear.

**CERTIFICATE HOLDER**

Moline-Coal Valley CUSD 40
ATTN: Dave McDermott
1619 11th Avenue
Moline, IL 61265

**CANCELLATION**

**SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.**

**AUTHORIZED REPRESENTATIVE**

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**SECTION 00 50 00**
**CONTRACTING FORMS AND SUPPLEMENTS**

## PART 1 GENERAL

### 1.01 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. The Agreement is based on AIA A101.

B. The General Conditions are based on AIA A201.

### 1.02 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.

B. Bond Forms:
   1. Bid Bond Form: AIA A310.

C. Post-Award Certificates and Other Forms:
   1. Schedule of Values Form: AIA G703.
   2. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).

D. Closeout Forms:
   1. Certificate of Substantial Completion Form: AIA G704.

### 1.03 REFERENCE STANDARDS

A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.

B. AIA A201 - General Conditions of the Contract for Construction; 2017.

C. AIA A310 - Bid Bond; 2010.

D. AIA G702 - Application and Certificate for Payment; 1992.

E. AIA G703 - Continuation Sheet; 1992.

F. AIA G704 - Certificate of Substantial Completion; 2017.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION - NOT USED

**END OF SECTION 00 50 00**

DRAFT

# AIA® Document A101® – 2017

## *Standard Form of Agreement Between Owner and Contractor*

*where the basis of payment is a Stipulated Sum*

**AGREEMENT** made as of the « » day of « » in the year « »
*(In words, indicate day, month and year.)*

**BETWEEN** the Owner:
*(Name, legal status, address and other information)*

« Moline-Coal Valley School District No. 40 »
« 1900 52nd Avenue »
« Moline, Illinois 61265 »
« Telephone Number: (309) 743-1600 »

and the Contractor:
*(Name, legal status, address and other information)*

« »« »
« »
« »
« »

for the following Project:
*(Name, location and detailed description)*

« Moline-Coal Valley School District No. 40 »
« 2026 Facility Improvements »

The Architect:
*(Name, legal status, address and other information)*

« Legat Architects, Inc. »
« 1515 5th Avenue, Suite 108 »
« Moline, Illinois 61265 »
« Telephone Number: (309) 517-5536 »

The Owner and Contractor agree as follows.

**ADDITIONS AND DELETIONS:** The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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**TABLE OF ARTICLES**


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**EXHIBIT A INSURANCE AND BONDS**


## ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

## ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

## ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

**§ 3.1** The date of commencement of the Work shall be:
*(Check one of the following boxes.)*

[ « » ] The date of this Agreement.

[ « » ] A date set forth in a notice to proceed issued by the Owner.

[ « » ] Established as follows:
*(Insert a date or a means to determine the date of commencement of the Work.)*

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

**§ 3.2** The Contract Time shall be measured from the date of commencement of the Work.

### § 3.3 Substantial Completion

**§ 3.3.1** Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
*(Check one of the following boxes and complete the necessary information.)*


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[ « » ] Not later than « » ( « » ) calendar days from the date of commencement of the Work.

[ « » ] By the following date: « »

**§ 3.3.2** Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

| Portion of Work | Substantial Completion Date |
|---|---|
| | |

**§ 3.3.3** If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

## ARTICLE 4 CONTRACT SUM

**§ 4.1** The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « » ), subject to additions and deductions as provided in the Contract Documents.

### § 4.2 Alternates

**§ 4.2.1** Alternates, if any, included in the Contract Sum:

| Item | Price |
|---|---|
| | |

**§ 4.2.2** Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
*(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)*

| Item | Price | Conditions for Acceptance |
|---|---|---|
| | | |

**§ 4.3** Allowances, if any, included in the Contract Sum:
*(Identify each allowance.)*

| Item | Price |
|---|---|
| | |

**§ 4.4** Unit prices, if any:
*(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)*

| Item | Units and Limitations | Price per Unit ($0.00) |
|---|---|---|
| | | |

**§ 4.5** Liquidated damages, if any:
*(Insert terms and conditions for liquidated damages, if any.)*

« »

**§ 4.6** Other:
*(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*

« »

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## ARTICLE 5 PAYMENTS

### § 5.1 Progress Payments

**§ 5.1.1** Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

**§ 5.1.2** The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

**§ 5.1.3** Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « » ( « » ) days after the Architect receives the Application for Payment.
*(Federal, state or local laws may require payment within a certain period of time.)*

**§ 5.1.4** Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

**§ 5.1.5** Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

**§ 5.1.6** In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

**§ 5.1.6.1** The amount of each progress payment shall first include:

- **.1** That portion of the Contract Sum properly allocable to completed Work;
- **.2** That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- **.3** That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

**§ 5.1.6.2** The amount of each progress payment shall then be reduced by:

- **.1** The aggregate of any amounts previously paid by the Owner;
- **.2** The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- **.3** Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- **.4** For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- **.5** Retainage withheld pursuant to Section 5.1.7.

### § 5.1.7 Retainage

**§ 5.1.7.1** For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
*(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)*

« »

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**§ 5.1.7.1.1** The following items are not subject to retainage:
*(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)*

« »

**§ 5.1.7.2** Reduction or limitation of retainage, if any, shall be as follows:
*(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)*

« »

**§ 5.1.7.3** Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
*(Insert any other conditions for release of retainage upon Substantial Completion.)*

« »

**§ 5.1.8** If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

**§ 5.1.9** Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

### § 5.2 Final Payment

**§ 5.2.1** Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

**.1** the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

**.2** a final Certificate for Payment has been issued by the Architect.

**§ 5.2.2** The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

### § 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
*(Insert rate of interest agreed upon, if any.)*

« » % « »

## ARTICLE 6 DISPUTE RESOLUTION

### § 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
*(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)*

« »
« »

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« »
« »

**§ 6.2 Binding Dispute Resolution**
For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
*(Check the appropriate box.)*

[ « » ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ « » ] Litigation in a court of competent jurisdiction

[ « » ] Other *(Specify)*

« »

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

**ARTICLE 7 TERMINATION OR SUSPENSION**
**§ 7.1** The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

**§ 7.1.1** If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
*(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)*

« »

**§ 7.2** The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

**ARTICLE 8 MISCELLANEOUS PROVISIONS**
**§ 8.1** Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

**§ 8.2** The Owner's representative:
*(Name, address, email address, and other information)*

« »
« »
« »
« »
« »
« »

**§ 8.3** The Contractor's representative:
*(Name, address, email address, and other information)*

« »
« »
« »
« »
« »
« »

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**§ 8.4** Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

**§ 8.5 Insurance and Bonds**

**§ 8.5.1** The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

**§ 8.5.2** The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

**§ 8.6** Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with a building information modeling exhibit, if completed, or as otherwise set forth below:
*(If other than in accordance with a building information modeling exhibit, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)*

« »

**§ 8.7** Other provisions:

« »

## ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

**§ 9.1** This Agreement is comprised of the following documents:

**.1** AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

**.2** AIA Document A101™–2017, Exhibit A, Insurance and Bonds

**.3** AIA Document A201™–2017, General Conditions of the Contract for Construction

**.4** Building information modeling exhibit, dated as indicated below:
*(Insert the date of the building information modeling exhibit incorporated into this Agreement.)*

« »

**.5** Drawings

| Number | Title | Date |
|---|---|---|
| | | |

**.6** Specifications

| Section | Title | Date | Pages |
|---|---|---|---|
| | | | |

**.7** Addenda, if any:

| Number | Date | Pages |
|---|---|---|
| | | |

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

**.8** Other Exhibits:
*(Check all boxes that apply and include appropriate information identifying the exhibit where required.)*

[ « » ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:

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*(Insert the date of the E204-2017 incorporated into this Agreement.)*

« »

[ « » ] The Sustainability Plan:

| Title | Date | Pages |
|---|---|---|
| | | |

[ « » ] Supplementary and other Conditions of the Contract:

| Document | Title | Date | Pages |
|---|---|---|---|
| | | | |

**.9** Other documents, if any, listed below:
*(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)*

« »

This Agreement entered into as of the day and year first written above.

| **OWNER** *(Signature)* | **CONTRACTOR** *(Signature)* |
|---|---|
| « »« » | « »« » |
| *(Printed name and title)* | *(Printed name and title)* |

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DRAFT **AIA® Document A101® – 2017**

# Exhibit A

## *Insurance and Bonds*

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the « » day of « » in the year « »
*(In words, indicate day, month and year.)*

for the following **PROJECT**:
*(Name and location or address)*

« Moline-Coal Valley School District No. 40 »
« 2026 Facility Improvements »

**THE OWNER:**
*(Name, legal status and address)*

« Moline-Coal Valley School District No. 40 »
« 1900 52nd Avenue »
« Moline, Illinois 61265 »
« Telephone Number: (309) 743-1600 »

**THE CONTRACTOR:**
*(Name, legal status and address)*

« »« »
« »

**TABLE OF ARTICLES**


**A.1 GENERAL**

**A.2 OWNER'S INSURANCE**

**A.3 CONTRACTOR'S INSURANCE AND BONDS**

**A.4 SPECIAL TERMS AND CONDITIONS**


### ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

### ARTICLE A.2 OWNER'S INSURANCE

#### § A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

**ADDITIONS AND DELETIONS:** The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A201®–2017, General Conditions of the Contract for Construction. Article 11 of A201®–2017 contains additional insurance provisions.

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**§ A.2.2 Liability Insurance**
The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.

**§ A.2.3 Required Property Insurance**
**§ A.2.3.1** Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

**§ A.2.3.1.1 Causes of Loss.** The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
*(Indicate below the cause of loss and any applicable sub-limit.)*

| Causes of Loss | Sub-Limit |
| --- | --- |
| | |

**§ A.2.3.1.2 Specific Required Coverages.** The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:
*(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)*

| Coverage | Sub-Limit |
| --- | --- |
| | |

**§ A.2.3.1.3** Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

**§ A.2.3.1.4 Deductibles and Self-Insured Retentions.** If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

**§ A.2.3.2 Occupancy or Use Prior to Substantial Completion.** The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

**§ A.2.3.3 Insurance for Existing Structures**
If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

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**§ A.2.4 Optional Extended Property Insurance.**
The Owner shall purchase and maintain the insurance selected and described below.
*(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)*

[ « » ] **§ A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance**, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

« »

[ « » ] **§ A.2.4.2 Ordinance or Law Insurance**, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

« »

[ « » ] **§ A.2.4.3 Expediting Cost Insurance**, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

« »

[ « » ] **§ A.2.4.4 Extra Expense Insurance**, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

« »

[ « » ] **§ A.2.4.5 Civil Authority Insurance**, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

« »

[ « » ] **§ A.2.4.6 Ingress/Egress Insurance**, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

« »

[ « » ] **§ A.2.4.7 Soft Costs Insurance**, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

« »

**§ A.2.5 Other Optional Insurance.**
The Owner shall purchase and maintain the insurance selected below.

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*(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)*

[ « » ] **§ A.2.5.1 Cyber Security Insurance** for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information. *(Indicate applicable limits of coverage or other conditions in the fill point below.)*

« »

[ « » ] **§ A.2.5.2 Other Insurance**
*(List below any other insurance coverage to be provided by the Owner and any applicable limits.)*

| Coverage | Limits |
| --- | --- |
| | |

**ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS**

**§ A.3.1 General**

**§ A.3.1.1 Certificates of Insurance.** The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

**§ A.3.1.2 Deductibles and Self-Insured Retentions.** The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

**§ A.3.1.3 Additional Insured Obligations.** To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

**§ A.3.2 Contractor's Required Insurance Coverage**

**§ A.3.2.1** The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
*(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)*

« »

**§ A.3.2.2 Commercial General Liability**

**§ A.3.2.2.1** Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than « One Million Dollars » ($ « 1,000,000.00 » ) each occurrence, « One Million Dollars » ($ « 1,000,000.00 » ) general aggregate, and « One Million Dollars » ($ « 1,000,000.00 » ) aggregate for products-completed operations hazard, providing coverage for claims including

**.1** damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;

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.2 personal injury and advertising injury;
.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
.4 bodily injury or property damage arising out of completed operations; and
.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

**§ A.3.2.2.2** The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
.3 Claims for bodily injury other than to employees of the insured.
.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
.8 Claims related to roofing, if the Work involves roofing.
.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
.10 Claims related to earth subsidence or movement, where the Work involves such hazards.
.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

**§ A.3.2.3** Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than « One Million Dollars » ($ « 1,000,000.00 » ) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

**§ A.3.2.4** The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

**§ A.3.2.5** Workers' Compensation at statutory limits.

**§ A.3.2.6** Employers' Liability with policy limits not less than « One Hundred Thousand Dollars » ($ « 100,000.00 » ) each accident, « One Hundred Thousand Dollars » ($ « 100,000.00 » ) each employee, and « Five Hundred Thousand Dollars » ($ « 500,000.00 » ) policy limit.

**§ A.3.2.7** Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

**§ A.3.2.8** If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate.

**§ A.3.2.9** If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate.

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**§ A.3.2.10** Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate.

**§ A.3.2.11** Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate.

**§ A.3.2.12** Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate.

**§ A.3.3 Contractor's Other Insurance Coverage**

**§ A.3.3.1** Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
*(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)*

« »

**§ A.3.3.2** The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.
*(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)*

[ « » ] **§ A.3.3.2.1** Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
*(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)*

« »

[ « » ] **§ A.3.3.2.2 Railroad Protective Liability Insurance**, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate, for Work within fifty (50) feet of railroad property.

[ « » ] **§ A.3.3.2.3 Asbestos Abatement Liability Insurance**, with policy limits of not less than « » ($ « » ) per claim and « » ($ « » ) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ « » ] **§ A.3.3.2.4** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ « » ] **§ A.3.3.2.5** Property insurance on an "all-risks" completed value form, covering property owned by

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the Contractor and used on the Project, including scaffolding and other equipment.

[ « » ] **§ A.3.3.2.6 Other Insurance**
*(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)*

| Coverage | Limits |
| --- | --- |
| | |

**§ A.3.4 Performance Bond and Payment Bond**
The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
*(Specify type and penal sum of bonds.)*

| Type | Penal Sum ($0.00) |
| --- | --- |
| Payment Bond | |
| Performance Bond | |

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

**ARTICLE A.4 SPECIAL TERMS AND CONDITIONS**
Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

« »

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DRAFT

# AIA® Document A201® – 2017

## *General Conditions of the Contract for Construction*

**for the following PROJECT:**
*(Name and location or address)*

« Moline-Coal Valley School District No. 40 »
« 2026 Facility Improvements »

**THE OWNER:**
*(Name, legal status and address)*

« Moline-Coal Valley School District No. 40 »
« 1900 52nd Avenue »
« Moline, Illinois 61265 »
« Telephone Number: (309) 743-1600 »

**THE ARCHITECT:**
*(Name, legal status and address)*

« Legat Architects, Inc. »
« 1515 5th Avenue, Suite 108 »
« Moline, Illinois 61265 »
« Telephone Number: (309) 517-5536 »

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## ARTICLE 1 GENERAL PROVISIONS

### § 1.1 Basic Definitions

#### § 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

#### § 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

#### § 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

#### § 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### § 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### § 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### § 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

#### § 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

### § 1.2 Correlation and Intent of the Contract Documents

**§ 1.2.1** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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**§ 1.2.1.1** The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

**§ 1.2.2** Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

**§ 1.2.3** Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

### § 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### § 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### § 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

**§ 1.5.1** The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

**§ 1.5.2** The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

### § 1.6 Notice

**§ 1.6.1** Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

**§ 1.6.2** Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

### § 1.7 Digital Data Use and Transmission

The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

### § 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

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## ARTICLE 2 OWNER

### § 2.1 General

**§ 2.1.1** The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

**§ 2.1.2** The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

### § 2.2 Evidence of the Owner's Financial Arrangements

**§ 2.2.1** Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

**§ 2.2.2** Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

**§ 2.2.3** After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

**§ 2.2.4** Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

### § 2.3 Information and Services Required of the Owner

**§ 2.3.1** Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

**§ 2.3.2** The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

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**§ 2.3.3** If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

**§ 2.3.4** The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

**§ 2.3.5** The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

**§ 2.3.6** Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

### § 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

### § 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

## ARTICLE 3 CONTRACTOR

### § 3.1 General

**§ 3.1.1** The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

**§ 3.1.2** The Contractor shall perform the Work in accordance with the Contract Documents.

**§ 3.1.3** The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

### § 3.2 Review of Contract Documents and Field Conditions by Contractor

**§ 3.2.1** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

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**§ 3.2.2** Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

**§ 3.2.3** The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

**§ 3.2.4** If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

### § 3.3 Supervision and Construction Procedures

**§ 3.3.1** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

### § 3.4 Labor and Materials

**§ 3.4.1** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**§ 3.4.2** Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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**§ 3.4.3** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

### § 3.5 Warranty

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

**§ 3.5.2** All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### § 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

### § 3.7 Permits, Fees, Notices and Compliance with Laws

**§ 3.7.1** Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

**§ 3.7.2** The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

**§ 3.7.3** If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### § 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

**§ 3.7.5** If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the

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Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

### § 3.8 Allowances

**§ 3.8.1** The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

**§ 3.8.2** Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

**§ 3.8.3** Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

### § 3.9 Superintendent

**§ 3.9.1** The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

**§ 3.9.2** The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

**§ 3.9.3** The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

### § 3.10 Contractor's Construction and Submittal Schedules

**§ 3.10.1** The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

**§ 3.10.2** The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

**§ 3.10.3** The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

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### § 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

### § 3.12 Shop Drawings, Product Data and Samples

**§ 3.12.1** Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

**§ 3.12.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**§ 3.12.3** Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

**§ 3.12.4** Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

**§ 3.12.6** By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**§ 3.12.7** The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

**§ 3.12.8** The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

**§ 3.12.9** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

**§ 3.12.10** The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's

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responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

**§ 3.12.10.1** If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

**§ 3.12.10.2** If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

### § 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

### § 3.14 Cutting and Patching

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

### § 3.15 Cleaning Up

**§ 3.15.1** The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

**§ 3.15.2** If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

### § 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

### § 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in

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Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### § 3.18 Indemnification

**§ 3.18.1** To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

## ARTICLE 4 ARCHITECT

### § 4.1 General

**§ 4.1.1** The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

**§ 4.1.2** Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

### § 4.2 Administration of the Contract

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

**§ 4.2.2** The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

### § 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any

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direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

**§ 4.2.5** Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

**§ 4.2.6** The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

**§ 4.2.7** The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

**§ 4.2.8** The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

**§ 4.2.9** The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

**§ 4.2.10** If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

**§ 4.2.11** The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

**§ 4.2.12** Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

**§ 4.2.13** The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

**§ 4.2.14** The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with

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reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## ARTICLE 5 SUBCONTRACTORS

### § 5.1 Definitions

**§ 5.1.1** A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

**§ 5.1.2** A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

### § 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

**§ 5.2.1** Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

**§ 5.2.2** The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

**§ 5.2.3** If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

**§ 5.2.4** The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

### § 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

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### § 5.4 Contingent Assignment of Subcontracts

**§ 5.4.1** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

**.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

**.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

**§ 5.4.2** Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

**§ 5.4.3** Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

## ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

### § 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

**§ 6.1.1** The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

**§ 6.1.4** Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

### § 6.2 Mutual Responsibility

**§ 6.2.1** The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible

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for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

**§ 6.2.3** The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

**§ 6.2.4** The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

**§ 6.2.5** The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

### § 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

## ARTICLE 7 CHANGES IN THE WORK

### § 7.1 General

**§ 7.1.1** Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

**§ 7.1.2** A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

**§ 7.1.3** Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

### § 7.2 Change Orders

**§ 7.2.1** A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

### § 7.3 Construction Change Directives

**§ 7.3.1** A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

**§ 7.3.2** A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

**§ 7.3.3** If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

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**.4** As provided in Section 7.3.4.

**§ 7.3.4** If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

**.1** Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

**.2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

**.3** Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

**.4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

**.5** Costs of supervision and field office personnel directly attributable to the change.

**§ 7.3.5** If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

**§ 7.3.6** Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

**§ 7.3.7** A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

**§ 7.3.8** The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

**§ 7.3.9** Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

**§ 7.3.10** When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

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## ARTICLE 8 TIME

### § 8.1 Definitions

**§ 8.1.1** Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

**§ 8.1.2** The date of commencement of the Work is the date established in the Agreement.

**§ 8.1.3** The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

**§ 8.1.4** The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

### § 8.2 Progress and Completion

**§ 8.2.1** Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

**§ 8.2.2** The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

**§ 8.2.3** The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

### § 8.3 Delays and Extensions of Time

**§ 8.3.1** If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

**§ 8.3.2** Claims relating to time shall be made in accordance with applicable provisions of Article 15.

**§ 8.3.3** This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

## ARTICLE 9 PAYMENTS AND COMPLETION

### § 9.1 Contract Sum

**§ 9.1.1** The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

**§ 9.1.2** If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### § 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

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### § 9.3 Applications for Payment

**§ 9.3.1** At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

**§ 9.3.1.1** As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

**§ 9.3.1.2** Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

**§ 9.3.2** Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

**§ 9.3.3** The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

### § 9.4 Certificates for Payment

**§ 9.4.1** The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

### § 9.5 Decisions to Withhold Certification

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the

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Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

**§ 9.5.2** When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

**§ 9.5.3** When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

**§ 9.5.4** If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

### § 9.6 Progress Payments

**§ 9.6.1** After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

**§ 9.6.2** The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

**§ 9.6.3** The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

**§ 9.6.4** The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

**§ 9.6.5** The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

**§ 9.6.6** A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

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**§ 9.6.7** Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

**§ 9.6.8** Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

### § 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

### § 9.8 Substantial Completion

**§ 9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

**§ 9.8.2** When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.4** When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

**§ 9.8.5** The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

### § 9.9 Partial Occupancy or Use

**§ 9.9.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented

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to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

**§ 9.9.2** Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**§ 9.9.3** Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

### § 9.10 Final Completion and Final Payment

**§ 9.10.1** Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**§ 9.10.2** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

**§ 9.10.3** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

**§ 9.10.4** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;

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.3 terms of special warranties required by the Contract Documents; or
.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

**§ 9.10.5** Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

### § 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

### § 10.2 Safety of Persons and Property

**§ 10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

**§ 10.2.2** The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

**§ 10.2.3** The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

**§ 10.2.4** When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

**§ 10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

**§ 10.2.6** The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

**§ 10.2.7** The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

### § 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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### § 10.3 Hazardous Materials and Substances

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

**§ 10.3.2** Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

**§ 10.3.3** To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

**§ 10.3.4** The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

**§ 10.3.5** The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

**§ 10.3.6** If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

### § 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

## ARTICLE 11 INSURANCE AND BONDS

### § 11.1 Contractor's Insurance and Bonds

**§ 11.1.1** The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The

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Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

**§ 11.1.2** The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

**§ 11.1.3** Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

**§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

**§ 11.2 Owner's Insurance**

**§ 11.2.1** The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

**§ 11.2.2 Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

**§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

**§ 11.3 Waivers of Subrogation**

**§ 11.3.1** The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds

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of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

**§ 11.3.2** If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

### § 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

### §11.5 Adjustment and Settlement of Insured Loss

**§ 11.5.1** A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

**§ 11.5.2** Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

## ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

### § 12.1 Uncovering of Work

**§ 12.1.1** If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

**§ 12.1.2** If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

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### § 12.2 Correction of Work

#### § 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

#### § 12.2.2 After Substantial Completion

**§ 12.2.2.1** In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

**§ 12.2.2.2** The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

**§ 12.2.2.3** The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

**§ 12.2.3** The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

**§ 12.2.4** The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

**§ 12.2.5** Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

### § 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## ARTICLE 13 MISCELLANEOUS PROVISIONS

### § 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

### § 13.2 Successors and Assigns

**§ 13.2.1** The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the

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other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

**§ 13.2.2** The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

### § 13.3 Rights and Remedies

**§ 13.3.1** Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

**§ 13.3.2** No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

### § 13.4 Tests and Inspections

**§ 13.4.1** Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

**§ 13.4.2** If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

**§ 13.4.3** If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

**§ 13.4.4** Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

**§ 13.4.5** If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

**§ 13.4.6** Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

### § 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

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## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

**§ 14.1.1** The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

**§ 14.1.2** The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

**§ 14.1.3** If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

**§ 14.1.4** If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

### § 14.2 Termination by the Owner for Cause

**§ 14.2.1** The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

**§ 14.2.2** When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

**§ 14.2.3** When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

**§ 14.2.4** If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

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the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

### § 14.3 Suspension by the Owner for Convenience

**§ 14.3.1** The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

**§ 14.3.2** The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- **.1** that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- **.2** that an equitable adjustment is made or denied under another provision of the Contract.

### § 14.4 Termination by the Owner for Convenience

**§ 14.4.1** The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

**§ 14.4.2** Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- **.1** cease operations as directed by the Owner in the notice;
- **.2** take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- **.3** except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

**§ 14.4.3** In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

## ARTICLE 15 CLAIMS AND DISPUTES

### § 15.1 Claims

### § 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

### § 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

### § 15.1.3 Notice of Claims

**§ 15.1.3.1** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

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**§ 15.1.3.2** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

### § 15.1.4 Continuing Contract Performance

**§ 15.1.4.1** Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

**§ 15.1.4.2** The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

### § 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

### § 15.1.6 Claims for Additional Time

**§ 15.1.6.1** If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

**§ 15.1.6.2** If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

### § 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

### § 15.2 Initial Decision

**§ 15.2.1** Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

**§ 15.2.2** The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the

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Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

**§ 15.2.3** In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

**§ 15.2.4** If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

**§ 15.2.5** The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

**§ 15.2.6** Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

**§ 15.2.6.1** Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

**§ 15.2.7** In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

**§ 15.2.8** If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

### § 15.3 Mediation

**§ 15.3.1** Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

**§ 15.3.2** The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

**§ 15.3.3** Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

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**§ 15.3.4** The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

**§ 15.4 Arbitration**

**§ 15.4.1** If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

**§ 15.4.1.1** A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

**§ 15.4.2** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

**§ 15.4.3** The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

**§ 15.4.4 Consolidation or Joinder**

**§ 15.4.4.1** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

**§ 15.4.4.2** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

**§ 15.4.4.3** The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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**SECTION 00 82 00**
**PREVAILING WAGE REQUIREMENTS**

## PREVAILING WAGE REQUIREMENTS

### 2.01 REQUIREMENTS

A. Project: 2025 Facility Improvements at 4 Schools for Moline-Coal Valley School District No. 40.

B. The Contractor and each Subcontractor shall comply with requirements of Illinois Prevailing Wage Act, 820 ILCS Section 130/0.01.

C. Please refer to the Illinois Department of Labor's website at https://www2.illinois.gov/idol/laws-rules/conmed/pages/prevailing-wage-rates.aspx for the requirements and prerequisites of this Act as well as the text of the Act and all related regulations. Please refer questions concerning the Illinois Prevailing Wage Act or the Department of Labor's enforcement of this law, contact the Illinois Department of Labor's Prevailing Wage Division at (217) 782-1710.

D. A partial list of the requirements of the Illinois Prevailing Wage Act is listed after this document and is not intended to be a complete listing or official guide to the Illinois Prevailing Wage Act, but is provided herein to assist the Contractor in understanding some of the basic requirements:

1. All laborers, workers and mechanics employed by or on behalf of a public body in the construction of public works shall be paid the general prevailing rate of hourly wages for work of a similar character in the locality in which the work is performed. See 820 ILCS § 130/3.
2. If, during the course of work under this contract, the Department of Labor revises the prevailing rate hourly wages to be paid under this contract for any trade or occupation, Owner, will notify Contractor and each Subcontractor of the changes in the prevailing rate of hourly wages. Contractor shall have the sole responsibility and duty to ensure that the revised prevailing rate of hourly wages is paid by Contractor and all Subcontractors to each worker to whom a revised rate is applicable. Revisions to the prevailing wage as set forth above shall not result in an increase in the Contract Sum. See 820 ILCS § 130/4(a), (d).
3. The Contractor and each Subcontractor must insert a provision or stipulation regarding the payment of the prevailing wage rate into their subcontracts and contractor's bond. See 820 ILCS § 130/4(b), (c).
4. The Contractor and each Subcontractor who have been awarded public works contracts must post the relevant prevailing wage rate(s) at a location on the project site that is easily accessible by workers. See 820 ILCS §130/4(f).
5. The Contractor and all subcontractors shall conform to the Illinois Statutory requirements regarding the submission of Certified Transcripts of Payroll.
    a. Certified Transcripts of Payroll are to be prepared and are to document every hour worked by all persons identified by the Illinois Prevailing Wage Act who are employed by the Work of this project.
    b. Certified Transcripts of Payroll are to be submitted directly to the Illinois Department of Labor via their on-line, Certified Transcript of Payroll Portal no later than the 15th of each calendar month following a month in which construction on the project has occurred.
    c. The Contractor and all subcontractors shall provide original copies of the Certified Transcripts of Payroll to the Owner with each pay application.
    d. The Contractor and/or subcontractor(s) are aware that filing Certified Transcripts of Payroll known to be false is a class B misdemeanor. See 820 ILCS §130/5(a)(2).
6. The Contractor and each Subcontractor shall create, and keep for at least three years, records of all laborers, mechanics, and other workers employed by them on a public works project. See 820 ILCS § 130/5(a)(1), (b).

**END OF SECTION 00 82 00**

**SECTION 01 10 00**
**SUMMARY**

## PART 1 GENERAL

### 1.01 PROJECT

A. Project Name: 2026 Facility Improvements

B. Owner's Name: Moline-Coal Valley School District #40.

C. Architect's Name: Legat Architects, Inc..

D. The Project consists of the construction of 2026 Facility Improvements at 4 Schools.

### 1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

### 1.03 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing site during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

### 1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Arrange use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Others. The turf field and track to be removed and replaced under a separate contract. Contractors are responsible for coordinating work on site with turf and track contractors to ensure all parties are knowledgeable of the work happening.
   3. Work by Owner.
   4. Use of site and premises by the public.

C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Utility Outages and Shutdown:
   1. Prevent accidental disruption of utility services to other facilities.

**END OF SECTION 01 10 00**

**SECTION 01 20 00**
**PRICE AND PAYMENT PROCEDURES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

### 1.02 RELATED REQUIREMENTS

A. Section 00 50 00 - Contracting Forms and Supplements: Forms to be used.

B. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

C. Section 01 78 00 - Closeout Submittals: Project record documents.

### 1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

F. Include in each line item, the amount of Allowances specified in this section.

G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

H. Revise schedule to list approved Change Orders, with each Application For Payment.

### 1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

H. Submit one electronic and three hard-copies of each Application for Payment.

I. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

**1.05 MODIFICATION PROCEDURES**

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ____ days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 60 00.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
   4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
   3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Adjustments to the Contract Sum, excluding those calculated using unit prices, shall calculate overhead, profit, and general conditions combined at the following percentages of the cost attributed to the change in the Work:
   1. For the Contractor, for Work performed by the Contractor's own forces, add ten percent (10%) of the cost of the Work.
   2. For the Contractor, for Work performed by the Contractor's Subcontractors, add five percent (5%) of the cost of the Work.
   3. For each Subcontractor or Sub-subcontractor involved, for Work performed by the Subcontractor or Sub-subcontractor own forces, add ten percent (10%) of the cost of the Work.
   4. For each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractor, add five percent (5%) of the cost of the Work.
   5. When both additions and credits are involved in any one change, the allowance for overhead and profit shall be figured on the basis of the net increase, if any.

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

**1.06 APPLICATION FOR FINAL PAYMENT**

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 70 00.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 20 00**

**SECTION 01 21 00**
**ALLOWANCES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Contingency allowance.

### 1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

### 1.03 CONTINGENCY ALLOWANCE

A. Description: Allowance dollars to be used for unforseen Work related to the Work identified in the Contract Documents.

B. Scope of work to be determined in th field based on actual field conditions.

C. Contractor will provide a negotiated price for the determined scope of work.

D. Contractor's costs shall include products, materials, delivery, equipment rental, installation, labor, and payroll.

E. Contractor's costs shall exclude overhead, profit, insurance, and bonds which shall be included in the Base Bid and not in Allowance Authorizstion Request's (AARs).

F. Funds will be drawn from the Contingency Allowance only by approved Allowance Authorization Requests (AARs).

G. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

### 1.04 ALLOWANCES SCHEDULE

A. Butterworth Elementary School Contingency Allowance: Include the stipulated sum/price of $30,000 for use upon Owner's instructions.

B. Logan Elementary School Contingency Allowance: Include the stipulated sum/price of $30,000 for use upon Owner's instructions.

C. Moline High School Contingency Allowance: Include the stipulated sum/price of $30,000 for use upon Owner's instructions.

D. Washington Elementary School Contingency Allowance: Include the stipulated sum/price of $30,000 for use upon Owner's instructions.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION - NOT USED

**END OF SECTION 01 21 00**

**SECTION 01 25 00**
**SUBSTITUTION PROCEDURES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

### 1.02 RELATED REQUIREMENTS

A. Section 00 21 13 - Instructions to Bidders: Restrictions on timing of substitution requests.

B. Section 00 43 25 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).

C. Section 01 21 00 - Allowances, for cash allowances affecting this section.

D. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.

E. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

### 1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

### 1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

A. Provide products as specified unless substitutions are submitted in the manner described herin, accepted, and documented.

B. Products proposed for substitution that do not meet or exceed all aspects of the products specified will not b

C. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

D. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

F. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. CSI Substitution Request form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.
         4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
         5) Description of Substitution.
         6) Reason why the specified item cannot be provided.
         7) Differences between proposed substitution and specified item.
         8) Description of how proposed substitution affects other parts of work.
      c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
         1) Physical characteristics.
         2) In-service performance.
         3) Expected durability.
         4) Visual effect.
         5) Sustainable design features.
         6) Warranties.
         7) Other salient features and requirements.
         8) Include, as appropriate or requested, the following types of documentation:
            (a) Product Data:
            (b) Samples.
            (c) Certificates, test, reports or similar qualification data.
            (d) Drawings, when required to show impact on adjacent construction elements.
      d. Impact of Substitution:
         1) Savings to Owner for accepting substitution.
         2) Change to Contract Time due to accepting substitution.

G. Limit each request to a single proposed substitution item.

**3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

A. Prior to Bid Closing: Substitute products will be considered up to four (4) business days prior to bid closing. Requests received after this date will not be considered.
   1. When a request to substitute a prduct is made, Architect may approve the substitution and, if approved, will document the approval by issuing an Addendum to known bidders.

B. At Time of Bid Closing: Substitute products will be considered if submitted as an attachment to the bidding forms.

C. Submittal Time Restrictions:

1. Section 00 21 13 - Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

### 3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. After the Bid Closing: No substitutions will be considered unless one or more of the following conditions exist:
   1. Product is discontinued.
   2. Delays beyond control such as labor strikes, lockouts, severe weather conditions, fires, or acts of God which may preclude the production and/or delivery of products for purposes of the Project.

B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Substitutions will not be considered under one or more of the following circumstances:
   1. Failure to award subcontract in sufficient time;
   2. Failure to place orders to ensure delivery without delaying work.
   3. Insuufficient quantity of product;
   4. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   5. Without a separate written request.
   6. When acceptance will require revisions to Contract Documents.
   7. When they offer advantages solely to the Contractor.

### 3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

### 3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

### 3.06 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

**END OF SECTION 01 25 00**

**SECTION 01 30 00**
**ADMINISTRATIVE REQUIREMENTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. General administrative requirements.

B. Web-based project software service.

C. Electronic document submittal service.

D. Preconstruction meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Coordination drawings.

H. Submittals for review, information, and project closeout.

I. Number of copies of submittals.

J. Submittal procedures.

### 1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary

B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

### 1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

### 1.04 PROJECT COORDINATIOR

A. Project Coordinator: Contractor(s).

B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for site access, traffic, and parking facilities.

C. During construction, coordinate use of site and facilities through the Project Coordinator.

D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 10 00 - Summary.

F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

G. Make the following types of submittals to Architect through the Project Coordinator:
   1. Requests for Interpretation.
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Manufacturer's instructions and field reports.
   5. Applications for payment and change order requests.
   6. Progress schedules.
   7. Coordination drawings.
   8. Closeout submittals.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 WEB-BASED PROJECT SOFTWARE SERVICE

A. Web-Based Project Software Service: Provide, administer, and use web-based project software to host and manage project communication and documentation.
   1. Include, at minimum, the following features:
      a. Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
      b. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
      c. Workflow planning, allowing customization of workflow for each project entity.
      d. Creation, logging, tracking, and notification for project communications.
      e. Tracking of project communication statuses in real time, including timestamped response log.
      f. Procedures for viewing PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
      g. Processing and tracking of payment applications.
      h. Processing and tracking of contract modifications.
      i. Creation and distribution of meeting minutes.
      j. Document management for drawings, specifications, and coordination drawings, including revision control.
      k. Management of construction progress photographs.
      l. Mobile device compatibility.
      m. Creation of data analytics reports.
      n. Creation and export of editable logs for software functions. Provide Owner, Architect, and Architect's consultants with rights and ability to download logs when requested.
   2. Provide up to 20 user licenses for use by Owner, Architect, Architect's consultants, and other entities involved in the project.
   3. Comply with the software service's current published licensing agreements.
   4. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
      a. Representatives of Owner are scheduled and included in this training.
   5. Project Closeout: Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.
   6. Web-Based Project Software Services: The selected service is:

### 3.02 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.

5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.

C. Submittal Service as selected by the contractor.

D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

**3.03 PRECONSTRUCTION MEETING**

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract and Architect.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.

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

**3.04 PROGRESS MEETINGS**

A. Schedule and administer meetings throughout progress of the work at maximum monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.

4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Coordination of projected progress.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### 3.05 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.

C. Within 10 days after joint review, submit complete schedule.

D. Submit updated schedule with each Application for Payment.

### 3.06 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

### 3.07 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

### 3.08 SUBMITTALS FOR INFORMATION

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

B. Submit for Architect's knowledge as contract administrator or for Owner.

### 3.09 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

**3.10 NUMBER OF COPIES OF SUBMITTALS**

A. Documents for Review:
   1. Small Size Sheets, Not Larger Than 8-1/2 by 11 inches: Submit the number of copies that Contractor requires, plus one copy that will be retained by Architect.

B. Documents for Information: Submit one copy.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

**3.11 SUBMITTAL PROCEDURES**

A. General Requirements:
   1. Transmit using approved form.
   2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
   5. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
   6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   7. Provide space for Contractor and Architect review stamps.
   8. When revised for resubmission, identify all changes made since previous submission.
   9. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   10. Submittals not requested will not be recognized or processed.

**END OF SECTION 01 30 00**

**SECTION 01 40 00**
**QUALITY REQUIREMENTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Contractor's design-related professional design services.

G. Control of installation.

H. Mock-ups.

I. Tolerances.

J. Manufacturers' field services.

K. Defect Assessment.

### 1.02 RELATED REQUIREMENTS

A. Document 00 72 00 - General Conditions: Inspections and approvals required by public authorities.

B. Section 01 21 00 - Allowances: Allowance for payment of testing services.

C. Section 01 30 00 - Administrative Requirements: Submittal procedures.

D. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

### 1.03 REFERENCE STANDARDS

A. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2026.

B. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.

C. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.

D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

E. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

### 1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.

1. Design Services Types Required:
    a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
    b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

## 1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary hoist(s) and rigging.

## 1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
   1. Structural Design of Metal Fabrications: As described in Section 05 50 00 - Metal Fabrications.

## 1.07 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.

i. Results of test/inspection.
j. Compliance with Contract Documents.
k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

## 1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

## 1.09 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

### 1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 21 00; see Section 01 21 00 and applicable sections for description of services included in allowance.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

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

### 3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

### 3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

## 3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

## 3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

### 3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION 01 40 00**

## SECTION 01 41 00
## REGULATORY REQUIREMENTS

### PART 1 GENERAL

### 1.01 SUMMARY OF REFERENCE STANDARDS

A. Regulatory requirements applicable to this project are the following:

B. 28 CFR 35 - Nondiscrimination on the Basis of Disability in State and Local Government Services; Final Rule; Department of Justice; current edition.

C. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.

D. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

E. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

F. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.

G. State of Illinois amendments to some or all of the following.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

I. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 1 - Fire Code; 2024, with Errata.

K. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

R. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

### 1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements.

### 1.03 QUALITY ASSURANCE

A. Contractor's Designer Qualifications: Refer to Section - 01 40 00 - Quality Requirements.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

**END OF SECTION 01 41 00**

## SECTION 01 50 00
## TEMPORARY FACILITIES AND CONTROLS

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Dewatering

B. Temporary Controls: Barriers, enclosures, and fencing.

C. Security requirements.

D. Vehicular access and parking.

E. Waste removal facilities and services.

F. Project identification sign.

### 1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

### 1.03 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

B. Maintain temporary facilities in operable condition.

### 1.04 TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Electrical power, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

B. Existing facilities may be used.

C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

### 1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

### 1.06 FENCING

A. Location: Logan Elementary School for exterior turf.

B. Construction: Commercial grade chain link fence.

C. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

### 1.07 SECURITY

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

### 1.08 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

**1.09 WASTE REMOVAL**

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

**1.10 PROJECT IDENTIFICATION**

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner permission except those required by law.

**1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 50 00**

**SECTION 01 60 00**
**PRODUCT REQUIREMENTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

F. Procedures for Owner-supplied products.

G. Maintenance materials, including extra materials, spare parts, tools, and software.

### 1.02 RELATED REQUIREMENTS

A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

### 1.03 REFERENCE STANDARDS

### 1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

## PART 2 PRODUCTS

### 2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

### 2.02 NEW PRODUCTS

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

B. Use of products having any of the following characteristics is not permitted:

### 2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

## 2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

# PART 3 EXECUTION

## 3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

## 3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

## 3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

## 3.04 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

L. Prevent contact with material that may cause corrosion, discoloration, or staining.

M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION 01 60 00**

**SECTION 01 70 00**
**EXECUTION AND CLOSEOUT REQUIREMENTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.

C. Cutting and patching.

D. Surveying for laying out the work.

E. Cleaning and protection.

F. Starting of systems and equipment.

G. Demonstration and instruction of Owner personnel.

H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

I. General requirements for maintenance service.

### 1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.

D. Section 01 76 10 - Temporary Protective Coverings: Materials for protection of installed work.

E. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

F. Section 02 41 00 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.

### 1.03 REFERENCE STANDARDS

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.

5. Work of Owner or separate Contractor.

E. Project Record Documents: Accurately record actual locations of capped and active utilities.

**1.05 QUALIFICATIONS**

A. For demolition work, employ a firm specializing in the type of work required.

B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

**1.06 PROJECT CONDITIONS**

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

**1.07 COORDINATION**

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and

conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## PART 2 PRODUCTS

### 2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### 3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### 3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Control datum for survey is that established by Owner provided survey.

E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

H. Utilize recognized engineering survey practices.

I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and _____.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

K. Periodically verify layouts by same means.

L. Maintain a complete and accurate log of control and survey work as it progresses.

**3.04 GENERAL INSTALLATION REQUIREMENTS**

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

**3.05 ALTERATIONS**

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.

b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

**3.06 CUTTING AND PATCHING**

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

## 3.07 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

## 3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

## 3.09 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

## 3.10 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

### 3.11 ADJUSTING

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

### 3.12 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### 3.13 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### 3.14 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION 01 70 00**

## SECTION 01 76 10
## TEMPORARY PROTECTIVE COVERINGS

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Temporary protective coverings for installed floors, walls, and other surfaces.

### 1.02 RELATED REQUIREMENTS

### 1.03 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes available; and installation instructions.

### PART 2 PRODUCTS

### 2.01 GENERAL

A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:

### 2.02 MATERIALS

A. Sheet Materials:
   1. Recycled paperboard/plastic composite sheet.
   2. Recycled paperboard sheet.
   3. Plywood, 1/2 inch thick nominal.

B. Rolled Materials:
   1. Self-adhering polyethylene film.

### PART 3 EXECUTION

### 3.01 PREPARATION

A. Remove dirt and debris from surfaces to be protected.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Trim or overlap sheet materials to fit area to be covered.

C. Roll out and cut rolled materials to fit area to be covered.

D. Tape seams. Avoid taping directly to finished surfaces.

E. Stretch self-adhering film materials to completely cover surface.

### 3.03 REMOVAL

A. Remove protective coverings prior to Date of Substantial Completion. Reuse or recycle materials if possible.

**END OF SECTION 01 76 10**

**SECTION 01 78 00**
**CLOSEOUT SUBMITTALS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

### 1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

### 1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.
   4. Reviewed shop drawings, product data, and samples.
   5. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

### 3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### 3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Additional information as specified in individual product specification sections.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### 3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

### 3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

**3.06 WARRANTIES AND BONDS**

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

**END OF SECTION 01 78 00**

**SECTION 02 41 00**
**DEMOLITION**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

### 1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.

E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

### 1.03 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

### 1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

### 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

### 1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of five years of documented experience.

## PART 2 PRODUCTS

### 2.01 MATERIALS

## PART 3 EXECUTION

### 3.01 DEMOLITION

A. Remove concrete slabs on grade as indicated on drawings.

B. Remove fences and gates as indicated on drawings.

C. Remove other items indicated, for salvage, relocation, and recycling.

D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

## 3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

E. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

## 3.03 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

### 3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
   1. Prevent movement of structure. Provide shoring and bracing as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch to match new work.

### 3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION 02 41 00**

**SECTION 03 30 00**
**CAST-IN-PLACE CONCRETE**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Floors and slabs on grade.

B. Joint devices associated with concrete work.

C. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.

D. Concrete curing.

### 1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

### 1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ACI PRC-223 - Shrinkage-Compensating Concrete - Guide; 2021.

D. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

E. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

F. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

G. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

H. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

I. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

J. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

K. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

M. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.

N. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

O. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

P. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.

Q. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

R. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

S. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

T. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

U. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

V. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2023.

W. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

X. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

Y. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2024.

Z. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

AA. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.

BB. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

CC. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

DD. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

EE. ASTM E1155/E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2023.

FF. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

GG. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

HH. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete; 1992.

## 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
   2. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions,.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Test Reports: Submit report for each test or series of tests specified.

F. Test Reports: Submit termite-resistant sheet manufacturer's summary of independent laboratory and field testing for effectiveness in subterranean termite exclusion.

G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

## 1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

B. Follow recommendations of ACI PRC-305 when concreting during hot weather.

C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

D. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for every day of placement.

### 1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Moisture Emission-Reducing Curing and Sealing Compound, Membrane-Forming: Provide warranty to cover cost of flooring delamination failures for 10 years.
   1. Include cost of repair or removal of failed flooring, remediation with a moisture vapor impermeable surface coating, and replacement of flooring with comparable flooring system.

## PART 2 PRODUCTS

### 2.01 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.

B. Blended Hydraulic Cement: ASTM C595/C595M, Type IS(20).

C. Fine and Coarse Aggregates: ASTM C33/C33M.

D. Lightweight Aggregate: ASTM C330/C330M.

E. Fly Ash: ASTM C618, Class C or F.

F. Calcined Pozzolan: ASTM C618, Class N.

G. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.

H. Silica Fume: ASTM C1240, proportioned in accordance with ACI PRC-211.1.

### 2.02 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.

### 2.03 BONDING AND JOINTING PRODUCTS

A. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
   1. Material: ASTM D1751, cellulose fiber.

### 2.04 CURING MATERIALS

A. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
   1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
   2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
   3. VOC Content: Less than 100 g/L.
   4. Products:
      a. Floor Seal Technology, Inc; VaporSeal 309: www.floorseal.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.05 MIXING

A. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

### 3.02 PREPARATION

A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.

B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

### 3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

### 3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.

B. Place concrete for floor slabs in accordance with ACI PRC-302.1.

C. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

D. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

### 3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

### 3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. Maximum Variation of Surface Flatness:

1. Exposed Concrete Floors: 1/4 inch in 10 feet.
2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
3. Under Carpeting: 1/4 inch in 10 feet.

B. Correct the slab surface if tolerances are less than specified.

C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

## 3.07 CONCRETE FINISHING

A. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
   1. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.

B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal.

## 3.08 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

## 3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

## 3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

## 3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

**END OF SECTION 03 30 00**

**SECTION 03 54 00**
**CAST UNDERLAYMENT**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Liquid-applied self-leveling floor underlayment.
   1. Use cementitious type at existing floor slabs where new flooring is indicated.

### 1.02 RELATED REQUIREMENTS

A. Section 01 70 00 - Execution and Closeout Requirements: Alteration project procedures; selective demolition for remodeling.

### 1.03 REFERENCE STANDARDS

A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

B. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

D. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

E. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2021.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.

C. Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Instructions.

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

### 1.06 FIELD CONDITIONS

A. Do not install underlayment until floor penetrations and peripheral work are complete.

B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.

C. During the curing process, ventilate spaces to remove excess moisture.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Cementitious Underlayment:
   1. Basis of Design: ARDEX Engineered Cements; Ardex K 520 with ARDEX P51 Primer: www.ardexamericas.com/#sle.
   2. Custom Building Products; TechLevel XP-1 Self-Leveling Underlayment: www.custombuildingproducts.com/#sle.

3. LATICRETE International, Inc; LATICRETE NXT LEVEL PLUS with NXT PRIMER: www.laticrete.com/#sle.
4. Mapei Corporation; PlaniLevel 450: www.mapei.com/#sle.
5. Sika Corporation; Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 MATERIALS**

A. Cast Underlayments, General:
   1. Comply with applicable code for combustibility or flame spread requirements.

B. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
   1. Compressive Strength: Minimum 4000 pounds per square inch after 28 days, tested per ASTM C109/C109M.
   2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
   3. Density: 125 pounds per cubic foot, nominal.
   4. Final Set Time: 1-1/2 to 2 hours, maximum.
   5. Thickness: Capable of thicknesses from feather edge to maximum 3-1/2 inch.
   6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.

D. Primer: Manufacturer's recommended type.

E. Joint and Crack Filler: Latex-based filler, as recommended by manufacturer.

**2.03 MIXING**

A. Site mix materials in accordance with manufacturer's instructions.

B. Mix to self-leveling consistency without over-watering.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

**3.02 PREPARATION**

A. Concrete: Prepare surfaces according to ICRI 310.2R.

B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.

C. Vacuum clean surfaces.

D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.

E. Close floor openings.

**3.03 APPLICATION**

A. Install underlayment in accordance with manufacturer's instructions.

B. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.

**3.04 CURING**

A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.

B. Air cure in accordance with manufacturer's instructions.

### 3.05 PROTECTION

A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF SECTION 03 54 00**

**SECTION 05 52 13**
**PIPE AND TUBE RAILINGS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Stair railings and guardrails.

B. Free-standing railings at steps.

### 1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 09 91 13 - Exterior Painting: Paint finish.

C. Section 09 91 23 - Interior Painting: Paint finish.

### 1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

F. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.

G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

I. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

J. AWS C3.4M/C3.4 - Specification for Torch Brazing; 2016.

K. AWS C3.5M/C3.5 - Specification for Induction Brazing; 2026.

L. AWS C3.9M/C3.9 - Specification for Resistance Brazing; 2020.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

## PART 2 PRODUCTS

### 2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Comply with ASTM E985.

C. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Dimensions: See drawings for configurations and heights.

E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

F. Provide welding fittings  welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

G. Welded and Brazed Joints:  Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   1. Ease exposed edges to a small uniform radius.
   2. Welded Joints:
      a. Carbon Steel:  Perform welding in accordance with AWS D1.1/D1.1M.
      b. Stainless Steel:  Perform welding in accordance with AWS D1.6/D1.6M.
   3. Brass/Bronze Brazed Joints:
      a. Perform torch brazing in accordance with AWS C3.4M/C3.4.
      b. Perform induction brazing in accordance with AWS C3.5M/C 3.5.
      c. Perform resistance brazing in accordance with AWS C3.9M/C3.9.

### 2.02 STEEL RAILING SYSTEM

A. Welding Fittings:  Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

### 2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured.  Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components:  Continuously seal joined pieces by intermittent welds and plastic filler.  Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components:  Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface.  Make exposed joints butt tight, flush, and hairline.  Ease exposed edges to small uniform radius.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

### 3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

**3.04 TOLERANCES**

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION 05 52 13**

**SECTION 06 10 00**
**ROUGH CARPENTRY**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Miscellaneous framing and sheathing.

B. Concealed wood blocking, nailers, and supports.

### 1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

C. PS 1 - Structural Plywood; 2023.

D. PS 20 - American Softwood Lumber Standard; 2025.

E. SPIB (GR) - Standard Grading Rules; 2021.

### 1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

### 1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

### 2.02 DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

### 2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

### 3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### 3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and _____.

E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

### 3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Chalkboards and marker boards.
   4. Wall paneling and trim.
   5. Joints of rigid wall coverings that occur between studs.

### 3.05 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

### 3.06 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.

3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION 06 10 00**

**SECTION 06 41 00**
**ARCHITECTURAL WOOD CASEWORK**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

D. Preparation for installing utilities.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 12 36 00 - Countertops.

### 1.03 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. BHMA A156.9 - Cabinet Hardware; 2020.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

### 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

### 1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

### 1.07 MOCK-UPS

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.

B. See Section 01 40 00 - Quality Requirements for additional requirements.

C. Locate where directed.

D. Mock-up may remain as part of the work.

## 1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

## 1.09 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

# PART 2 PRODUCTS

## 2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

## 2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

## 2.03 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

## 2.04 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation; ____: www.formica.com/#sle.
   2. Panolam Industries International, Inc; _____: www.panolam.com/#sle.
   3. Wilsonart LLC; ____: www.wilsonart.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as indicated.
   3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, color as selected, finish as indicated.
   4. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness, through color, color as selected, finish as indicated.
   5. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, color as selected, finish as indicated.
   6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

## 2.05 LACQUERED PANELS

## 2.06 COUNTERTOPS

A. Countertops: See Section 12 36 00.

## 2.07 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded ABS or PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at all exposed shelf edges.
   3. Use at exposed door and drawer edges.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic or painted metal grommets for cut-outs, in color to match adjacent surface.

**2.08 HARDWARE**

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: As indicated on drawings.
   2. Product Grade: Grade 2.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.

D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.

E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
   1. Provide locks on all teachers wardrobe units.
   2. Each room to be keyed individually and tied into master keyed system.

F. Cabinet Catches and Latches:
   1. Type: Push latch.

G. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.
   6. Manufacturers:
      a. Accuride International, Inc; Heavy-Duty Drawer Slides: www.accuride.com/#sle.
      b. Grass America Inc; ____: www.grassusa.com/#sle.
      c. Hettich America, LP; _____: www.hettich.com/#sle.
      d. Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

H. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
   1. Manufacturers:
      a. Grass America Inc; ____: www.grassusa.com/#sle.
      b. Hardware Resources; _____: www.hardwareresources.com/#sle.
      c. Hettich America, LP; _____: www.hettich.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

I. Hooks: Surface-mounted; stainless steel, satin finish.

**2.09 FABRICATION**

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

### 3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

### 3.03 ADJUSTING

### 3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION 06 41 00**

**SECTION 07 92 00**
**JOINT SEALANTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 08 80 00 - Glazing: Glazing sealants and accessories.

B. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

### 1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Installation instructions, including precautions, limitations, and recommended backing materials and tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Installation Plan: Submit at least four weeks prior to start of installation.

G. Installation Log: Submit filled-out log for each length or instance of sealant installed.

H. Manufacturer's qualification statement.

I. Executed warranty.

## 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

D. Installation Plan: Include schedule of sealed joints, including the following:
   1. Installation Log Form: Include the following data fields, with known information filled out.
      a. Date of installation.
      b. Name of installer.
      c. Actual joint width; provide space to indicate maximum and minimum width.
      d. Actual joint depth to face of backing material at centerline of joint.
      e. Air temperature.

## 1.06 MOCK-UP

A. Provide mock-up of sealant joints in conjunction with wall under provisions of Section 01 40 00.

B. Construct mock-up with specified sealant types and with other components noted.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

## 1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

## 1.08 COORDINATION

A. Coordinate the work with all sections referencing this section.

## 1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5 year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 5 year period commencing on Date of Substantial Completion.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow: www.dow.com/#sle.
   2. Pecora Corporation: www.pecora.com/#sle.
   3. Sika Corporation: usa.sika.com/#sle.
   4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   5. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Self-Leveling Sealants:

1. Bostik Inc: www.bostik-us.com/#sle.
2. Pecora Corporation: www.pecora.com/#sle.
3. Sika Corporation: usa.sika.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
5. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

**2.02 JOINT SEALANTS - GENERAL**

**2.03 NONSAG JOINT SEALANTS**

A. Type General Purpose Exterior Sealant - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Color: To be selected by Architect from manufacturer's standard range.
   3. Service Temperature Range: Minus 40 to 180 degrees F.
   4. Applications: Use for:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior joints for which no other sealant is indicated.

B. Type ___ - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Products:
      a. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
      b. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

**2.04 ACCESSORIES**

A. Sealant Backing Rod, Closed-Cell Type:
   1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
   2. Size: Oversized 30 to 50 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

D. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

**3.02 PREPARATION**

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

## 3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

## 3.04 CLEANING

A. Clean adjacent soiled surfaces.

## 3.05 PROTECTION

A. Protect sealants until cured.

## 3.06 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

**END OF SECTION 07 92 00**

**SECTION 08 11 13**
**HOLLOW METAL DOORS AND FRAMES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal borrowed lites glazing frames.

### 1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

C. Section 09 91 13 - Exterior Painting: Field painting.

D. Section 09 91 23 - Interior Painting: Field painting.

### 1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. ASCE: American Society of Civil Engineers.

C. HMMA: Hollow Metal Manufacturers Association.

D. NAAMM: National Association of Architectural Metal Manufacturers.

E. NFPA: National Fire Protection Association.

F. SDI: Steel Door Institute.

G. UL: Underwriters Laboratories.

### 1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

O. ITS (DIR) - Directory of Listed Products; Current Edition.

P. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

Q. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

R. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

S. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

T. UL (DIR) - Online Certifications Directory; Current Edition.

U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

### 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer's Qualification Statement.

### 1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM

A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

## 2.03 HOLLOW METAL DOORS

A. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 1 - Standard-duty.
    b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.
4. Door Finish: Factory primed and field finished.

## 2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
2. Frame Finish: Factory primed and field finished.

C. Interior Window Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Frame finish: Factory primed and field finished.
3. Frame Type: Fixed Frame

D. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.

E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

F. Transom Bars: Fixed, of profile same as jamb and head.

G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

**2.05 FINISHES**

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

**2.06 ACCESSORIES**

A. Glazing: As specified in Section 08 80 00, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Astragals for Double Doors: Specified in Section 08 71 00.

D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

E. Insulation for Frames: Provide mineral wool insulation at frames.

F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

**3.02 PREPARATION**

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

**3.03 INSTALLATION**

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 08 71 00.

E. Comply with glazing installation requirements of Section 08 80 00.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

**3.04 TOLERANCES**

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

### 3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

**END OF SECTION 08 11 13**

**SECTION 08 33 26**
**OVERHEAD COILING GRILLES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Overhead coiling metal grilles and operating hardware; electrically operated.

B. Wiring from electric circuit disconnect to operator and to control station.

### 1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Cylinder cores and keys.

B. Section 26 05 83 - Wiring Connections: Power to disconnect.

### 1.03 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; Current Edition.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

D. NEMA MG 00001 - Motors and Generators; 2024.

E. UL (DIR) - Online Certifications Directory; Current Edition.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide, manufacturer's data sheets on each product to be used , general construction component connections and details, and electrical equipment.
   1. Including but not limited to:
      a. Preparation instructions and recommendations.
      b. Storage and handling requirements and recommendations.
      c. Installation methods

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details. Provide shop

D. Samples: Two grille sections, 6 by 6 inch in size illustrating shape, color and finish texture.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Utilize an authorized installer of door manufacturer who has demonstrated e

C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

### 1.06 DELIVERY, STORAGE AND HANDLING

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

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requriements of local authorities having jurisdiction.

## 1.07 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 absolute limits.

## 1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for the electrical operator and its component parts against defects in material and workmanship. Complete forms in Owner name and register with manufacturer.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Overhead Coiling Grilles:
   1. Raynor Garage Doors; DuraGrille Standard Series, Model GSA: www.raynor.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 GRILLES AND COMPONENTS

A. Grille: Aluminum; horizontal bar curtain, coiling on overhead counterbalanced shaft.
   1. Finish: Anodized, color as selected by Architect.
   2. Lock Devices: Cylinder Lock for Motor Operated Doors. Provide interlock switch with cylinder lock..
   3. Electric operation.
   4. Mounting: As indicated on drawings.

B. Curtain: Round horizontal bars connected with vertical links.
   1. Horizontal bars: 5/16 inch diameter.
   2. Bar spacing: 2 inch on center.
   3. Link spacing: 9 inch on center.
   4. Vertical link assembly: Lateral movement of the vertical link to be contained by C-Clips. Vertical link assemblies to be held together by brass eyelets.
   5. Bar Ends: Provide with nylon runners for quiet operation.
   6. Bottom Bar: Back-to-back angles with tubular resilient cushion.

C. Guides: Extruded aluminum shapes with retainer grooves and continuous pvc strips inserts. Guides to be provided with removable curtain stops.

D. Hood Enclosure and Trim: Sheet metal; completely covering operating mechanisms; internally reinforced to maintain rigidity and shape.
   1. Material: Same metal as grille.

E. Lock Hardware:
   1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 08 71 00.
   2. For motor operated units, additional lock or latching mechanisms are not required.

F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

## 2.03 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

## 2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.

B. Electric Operators:
   1. Mounting: Side mounted.

2. Motor Enclosure:
    a. Interior Coiling Grilles: NEMA MG 00001, Type 1; open drip proof.
3. Motor Rating: 1/2 hp; continuous duty.
4. Motor Voltage: 115 volts, single phase, 60 Hz.
5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: NEMA EN 10250 Type 1.
7. Opening Speed: 12 inches per second.
8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Manual override in case of power failure.
10. Refer to Section 26 05 83 for electrical connections.

C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
1. 24 volt circuit.
2. Surface mounted, at interior door jamb.
3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
    a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

D. Safety Edge: Located at bottom of coiling grill, full width, electro-mechanical sensitized type, wired to stop and reverse grill direction upon striking object, hollow neoprene covered.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify Architect of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

### 3.02 INSTALLATION

A. Install grille unit assembly in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 26 05 83.

F. Complete wiring from disconnect to unit components.

G. Install enclosure and perimeter trim.

### 3.03 ADJUSTING

A. Adjust grille, hardware and operating assemblies for smooth and noiseless operation.

### 3.04 CLEANING

A. Clean grille and components.

B. Remove labels and visible markings.

### 3.05 PROTECTION

A. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove and leagally dispose of construction debris from project site.

B. Remove temporary coverings and protection of adjacent work areas. Repair or replace installed products damaged prior to or during installation.

C. Protect installed products until completion of project.

D. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 08 33 26**

**SECTION 08 36 13**
**SECTIONAL DOORS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Overhead sectional doors, electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

### 1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

D. DASMA 102 - American National Standard Specifications for Sectional Doors; 2018.

E. DASMA 105 - Test Method for Thermal Transmittance and Air Infiltration of Garage Doors and Rolling Doors; 2017.

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Show component construction, anchorage method, and hardware.

D. Samples: Two panel finish samples, 6 by 6 inch in size, illustrating color and finish.

E. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

I. Specimen warranty.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of experience.

B. Installer Qualifications: Utilize an authorized installer of door manufacturer who has demonstrated experience on projects of similar size and complexity.

C. Comply with applicable code for motor and motor control requirements.

## 1.05 DELIVERY, STORAGE AND HANDLING

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

## 1.06 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.

## 1.07 WARRANTY

A. Provide manufacturer's standard warranty against defects in material and workmanship, as further described with each model in Part 2 of this Section.

B. Manufacturer Warranty: Provide 3-year manufacturer warranty for electric operating equipment. Complete forms in Owner's name and register with manufacturer.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Sectional Doors:
   1. Raynor Garage Doors; ThermalSeal, Model TM200: www.raynor.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 PERFORMANCE REQUIREMENTS

A. Performance: Withstand positive and negative wind loads of 13.3 lb/sq ft without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.

B. Air Infiltration: Maximum air leakage of 0.40 cfm/sq ft is required. Testing shall be in accordance with DASMA 105 test procedure.

C. Air Leakage Rating: 0.12 cfm/sq ft with optional IECC Compliance Package.

D. Thermal Transmittance: U-factor of 0.21 Btu/hr sq ft degrees F, maximum, in accordance with DASMA 102.

## 2.03 STEEL DOORS

A. Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Door Panels: Steel construction; outer steel sheet of 26 gauge, 0.016 inch minimum thickness, flush profile; inner steel sheet of 26 gauge, 0.016 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed from commercial quality, rabbeted weather joints at meeting rails; polyurethane insulation.
   2. Door Nominal Thickness: 2 inches thick.
   3. Exterior Finish:
      a. Factory finished with polyester baked enamel; color as selected by Architect.
   4. Glazed Lites: Full panel width, one row; set in place with resilient glazing channel.
      a. Glazing: Fully tempered glass; insulated glass units; clear; 1/2 inch nominal overall thickness.
   5. Electric Operation: Electric control station.

## 2.04 COMPONENTS

A. Track:
   1. Material: Hot-dipped galvanized steel per ASTM A653/A653M, fully adjustable for adequate sealing of door to jamb or weatherseal.
   2. Configuration Type: Normal Headroom.
   3. Size: 2 inch.
   4. Jamb Type: Steel, wood, or masonry
      a. Mounting: Floor-to-header angles. 13 gauge minimum continuous angles from floor to door header. Angle Size: 2-5/16 x 4 inches (59 x 102 mm)

B. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

C. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

D. Head Weatherstripping: EPDM rubber seal, one piece full length.

E. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

F. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

**2.05 MATERIALS**

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G40 Exterior coating, stucco embossed surface.

B. Float Glass: Provide float glass glazing, unless noted otherwise.
1. Heat-Strengthened and Fully Tempered Types: ASTM C1048.

C. Insulation: Expanded polystyrene (EPS), bonded to facing.
1. R-value of 18.3.

**2.06 ELECTRIC OPERATION**

A. Electric Operators:
1. Mounting: Side mounted on cross head shaft.
2. Motor Enclosure:
3. Motor Rating: 1/3 hp; continuous duty.
4. Motor Voltage: 120 volts, single phase, 60 Hz.
5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: NEMA EN 10250, Type 1.
7. Opening Speed: 12 inches per second.
8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Manual override in case of power failure.
10. See Section 26 05 83 for electrical connections.

B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.

C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
1. 24 volt circuit.
2. Surface mounted, at interior door jamb.
3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
   a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

D. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Do not begin installation until substrates have been properly prepared. Verify that site conditions are acceptable for installation of doors, operators, controls and accessories. Ensure that openings are square, flush and plumb.

B. Verify that electric power is available and of the correct characteristics.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.02 PREPARATION**

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

D. Apply primer to wood frame.

**3.03 INSTALLATION**

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

**3.04 ADJUSTING**

A. Lubricate bearings and sliding parts, assure weather tight fit around door perimeter and adjust doors for proper operations.

**3.05 CLEANING**

A. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove and legally dispose of construction debris from project site.

B. Remove temporary coverings and protections of adjacent work areas

**3.06 PROTECTION**

A. Touch-up, repair or replace damaged products before Substantial Completion.

B. Protect installed products from damage until Date of Substantial Completion.

C. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

**END OF SECTION 08 36 13**

**SECTION 08 43 13**
**ALUMINUM-FRAMED STOREFRONTS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Infill panels of metal and glass.

C. Aluminum doors and frames.

D. Weatherstripping.

### 1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.

C. Section 08 80 00 - Glazing: Glass and glazing accessories.

### 1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

K. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

N. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

P. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

**1.04 ADMINISTRATIVE REQUIREMENTS**

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

**1.05 SUBMITTALS**

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.06 QUALITY ASSURANCE**

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

**1.08 FIELD CONDITIONS**

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

**1.09 WARRANTY**

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Not Thermally-Broken:
   1. Basis of Design: Tubelite, Inc., Series E14000, Non-Thermally Broken Storefront Framing: www.tubeliteinc.com.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Front-Set Style, Thermally-Broken:
   1. Basis of Design: Tubelite, Inc., Series T14000, Thermally Broken Storefront Framing: www.tubeliteinc.com
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

C. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
   1. Kawneer, an Alcoa Company; www.kawneer.com
   2. Old Castle BE (Vistawall); www.oldcastlebe.com
   3. EFCO Corporation; www.efcocorp.com

D. Substitutions: See Section 01 60 00 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### 2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

A. Center-Set Style:
   1. Basis of Design: Tubelite, Inc., INT14 Interior Storefront: www.tubeliteinc.com.

### 2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Wide Stile, Insulating Glazing, Not Thermally-Broken:
   1. Basis of Design: Tubelite Inc. Standard Entrance Series: Wide Stile
   2. Thickness: 1-3/4 inches.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
   1. Kawneer, an Alcoa Company; www.kawneer.com
   2. Old Castle BE (Vistawall); www.oldcastlebe.com
   3. EFCO Corporation; www.efcocorp.com

### 2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Rabbet: For 1 inch insulating glazing.
   2. Finish: High performance organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   3. Finish Color: As selected by Architect from manufacturer's standard line.
   4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
10. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of IBC 2015.
   b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
4. System Assembly: Accomodate without damage to components or deterioration of selas, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.
5. Movement: Accomodate movement between storefront and perimeter framing and defelection lintel, without damage to components or deterioration of seals.
6. Vapor Seal: Limit vapor seal with interior atmospheric pressure of 1 inch (25 mm) sp, 72 degrees F (22 degrees C), 40 Percent RH without seal failure.
7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occuring in glazing channel, and migrating moisture occurring within system.
8. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.
9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour perior without causing detrimental effect to system components, anchorages, and other building elements.

**2.05 COMPONENTS**

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. Glazing: See Section 08 80 00.

C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches.
2. Top Rail: 5 inches wide.
3. Vertical Stiles: 5 inches wide.
4. Bottom Rail: 10 inches wide.

5. Glazing Stops: Square.
6. Finish: Same as storefront.

## 2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Fasteners: Stainless steel.

E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

G. Sealant for Setting Thresholds: Non-curing butyl type.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

I. Glazing Accessories: See Section 08 80 00.

J. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

## 2.07 FINISHES

A. High Performance Organic Coating: AAMA 2604; multiple coats, thermally cured fluoropolymer system.

B. Color: As selected by Architect from manufacturer's standard range.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

## 2.08 HARDWARE

A. Other Door Hardware: See Section 08 71 00.

B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

## 3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Provide low pressure foamed-in-place insulation in shim spaces at perimeter of asembly to maintain continuity of thermal barrier.

J. Set thresholds in bed of sealant and secure.

K. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

L. Install perimeter sealant in accordance with Section 07 90 05.

M. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

**3.03 TOLERANCES**

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

**3.04 ADJUSTING**

A. Adjust operating hardware and sash for smooth operation.

**3.05 CLEANING**

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

**3.06 PROTECTION**

A. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION 08 43 13**

**SECTION 08 71 00**
**DOOR HARDWARE**

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Interior Aluminum Doors and Frames"

6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.

3) Name and manufacturer of each item.
4) Fastenings and other pertinent information.
5) Location of each hardware set cross-referenced to indications on Drawings.
6) Explanation of all abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for hardware.
8) Door and frame sizes and materials.
9) Degree of door swing and handing.
10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

## 1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Best 45K Series: 10 years
        2) Exit Devices
            a) Von Duprin: 10 years
        3) Closers
            a) LCN 4000 Series: 30 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in ''Acceptable Manufacturers'' is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

## 2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

## 2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.

2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

## 2.04 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

   a. Best 45H Series

2. Acceptable Manufacturers and Products:

   a. No Substitute

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
6. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.

7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

## 2.05 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

## 2.06 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Best Keying Systems

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

## 2.07 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner’s existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner’s Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.
      3) Stamp cylinders/cores and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
      4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
      5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   e. Quantity: Furnish in the following quantities.
      1) Permanent Control Keys: 3.
      2) Master Keys: 6.
      3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
      4) Key Blanks: Quantity as determined in the keying meeting.

## 2.08 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

## 2.09 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

## 2.10 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

## 2.11 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## 2.12 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.13 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.14 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

2. Acceptable Manufacturers:
   a. GE-Interlogix

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

## 2.15 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum

10. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

## 3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

## 3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

## 3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

| Abbreviation | Name |
|---|---|
| BES | Best Locking Systems |
| GLY | Glynn-Johnson Corp |
| IVE | H.B. Ives |
| LCN | LCN Commercial Division |
| SCE | Schlage Electronic Security |
| VON | Von Duprin |
| ZER | Zero International Inc |

145740 OPT0466998 Version 1

Legend:
Link to catalog cut sheet
Electrified Opening

Hardware Group No. 01

For use on Door #(s):
F107B

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - CLASSROM | 45H-7-R-15R | | 626 | BES |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | WALL STOP | WS406/407CVX | | US26D | IVE |
| 3 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 01.1

For use on Door #(s):
F104A

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - CLASSROM | 45H-7-R-15R | | 626 | BES |
| 1 | EA | OH STOP & HOLDER | 90H | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP RW/62A | | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | | BLK | IVE |
| 3 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 01.2

For use on Door #(s):
F104B

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - CLASSROM | 45H-7-R-15R | | 626 | BES |
| 1 | EA | CLOSER WITH HOLD OPEN | 4040XP HEDA | | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | | BLK | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | | US26D | IVE |
| 3 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 02

For use on Door #(s):
F100A

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 5 X 4.5 | | 652 | IVE |
| 1 | EA | PANIC HARDWARE | LD-98-L-2SI-06 | | US26D | VON |
| 2 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 1 | EA | OH STOP | 90S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP RW/62A | | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | | BLK | IVE |
| 3 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 03

For use on Door #(s):
D101D

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - PRIVACY W/ INDICATOR | 45H-0-LT-15R-VIN | | 626 | BES |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | | BLK | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | | US26D | IVE |
| 3 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 04

For use on Door #(s):
D101B

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 1 | EA | CONT. HINGE | 224HD | | US28 | IVE |
| 1 | EA | PANIC HARDWARE - NIGHTLATCH | CDSI-98-NL-OP-110MD | | US32D | VON |
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 1 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 1 | EA | OH STOP | 90S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP RW/62A | | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | | BLK | IVE |
| 1 | EA | RAIN DRIP | 142A DW + 4" | | AA | ZER |
| 1 | EA | WEATHER STRIPPING | 328AA-S | | AA | ZER |
| 1 | EA | DOOR SWEEP | 39A | | A | ZER |
| 1 | EA | THRESHOLD | 655A-223 | | A | ZER |
| 1 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |

Hardware Group No. 05

For use on Door #(s):
D101A

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| | EA | OH Door - All Hardware by Door Mfg | | | |

Hardware Group No. 06

For use on Door #(s):
100

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 6 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | 689 | VON |
| 1 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | US26D | VON |
| 1 | EA | ELEC PANIC HARDWARE | RX-QEL-98-NL-OP-110MD-CON 24 VDC | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | 689 | VON |
| 2 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 2 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 2 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 2 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 2 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | SCH |
| 1 | EA | DESK MOUNT BUTTON | 660-PB | | 628 | SCE |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-4RL 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

DOOR NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES.
ENTRY BY CARD READER RETRACTS LATCH ALLOWING DOOR TO BE PULLED OPEN. ENTRY BY KEY OVERRIDE.
ENTRY BY REMOTE PUSH BUTTON RETRACTS LATCH ALLOWING DOOR TO BE PULLED OPEN.
BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.
CARD READER AND ELECTRICAL WIRING BY SECURITY CONTRACTOR.

Hardware Group No. 07

For use on Door #(s):
100A

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 1 | EA | SURF. AUTO OPERATOR | 4642 CS 120 VAC | | 689 | LCN |
| 2 | EA | ACTUATOR PKG - WIRELESS | 8310-3857TW | | 630 | LCN |

BALANCE OF HARDWARE EXISTING TO BE RE-USED. VERIFY AND COORDINATE NEW HARDWARE WITH EXISTING DOOR AND FRAME CONDITIONS.

Hardware Group No. 08

For use on Door #(s):
100B

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 2 | EA | CONT. HINGE | 112XY EPT TYPE AS REQ BY DOOR MFG | | US28 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | 689 | VON |
| 2 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | 689 | VON |
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 2 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 2 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 2 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 2 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 1 | EA | RAIN DRIP | 142A DW + 4" | | AA | ZER |
| 2 | EA | DOOR SWEEP | 39A | | A | ZER |
| 1 | EA | THRESHOLD | 655A-223 | | A | ZER |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | SCH |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-2RS 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

WEATHER STRIPPING BY ALUMINUM DOOR/FRAME MFG.

DOOR NORMALLY CLOSED, LATCHED AND SECURE.  FREE EGRESS AT ALL TIMES.
ENTRY BY KEY OVERRIDE.
BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.

Hardware Group No. 09

For use on Door #(s):
100C

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 2 | EA | CONT. HINGE | 112XY EPT TYPE AS REQ BY DOOR MFG | | US28 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | 689 | VON |
| 2 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | 689 | VON |
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 1 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | SURF. AUTO OPERATOR | 4642 CS 120 VAC | | 689 | LCN |
| 1 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 1 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 2 | EA | ACTUATOR PKG - WIRELESS | 8310-3857TW | | 630 | LCN |
| 1 | EA | RAIN DRIP | 142A DW + 4" | | AA | ZER |
| 2 | EA | DOOR SWEEP | 39A | | A | ZER |
| 1 | EA | THRESHOLD | 655A-223 | | A | ZER |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | SCH |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-4RL 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

WEATHER STRIPPING BY ALUMINUM DOOR/FRAME MFG.

DOOR NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES.
ENTRY BY CARD READER RETRACTS LATCH ALLOWING DOOR TO BE PULLED OPEN. ENTRY BY KEY OVERRIDE.
ENTRY BY ADA OPERATOR AS PROGRAMMED BY ACCESS CONTROL SYSTEM.
BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.
CARD READER AND ELECTRICAL WIRING BY SECURITY CONTRACTOR.

Hardware Group No. 10

For use on Door #(s):
100D

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | | FINISH | MFR |
|---|---|---|---|---|---|---|---|
| 2 | EA | CONT. HINGE | 112XY EPT TYPE AS REQ BY DOOR MFG | | | US28 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | | 689 | VON |
| 1 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | | US26D | VON |
| 1 | EA | ELEC PANIC HARDWARE | RX-QEL-98-NL-OP-110MD-CON 24 VDC | | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | | 689 | VON |
| 2 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | | US32D -316 | IVE |
| 2 | EA | CONC OH STOP | 100S | | | 630 | GLY |
| 2 | EA | SURFACE CLOSER | 4040XP EDA | | | 689 | LCN |
| 2 | EA | PA MOUNTING PLATE | 4040XP-18PA | | | 689 | LCN |
| 2 | EA | BLADE STOP SPACER | 4040XP-61 | | | 689 | LCN |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | | SCH |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-2RS 120/240 VAC | | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | | |

DOOR NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES.
ENTRY BY KEY OVERRIDE.
BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.

Hardware Group No. 11

For use on Door #(s):
100E

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 1 | EA | CONT. HINGE | 112XY EPT TYPE AS REQ BY DOOR MFG | | US28 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | 689 | VON |
| 2 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | 689 | VON |
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 2 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 2 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 2 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 2 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | SCH |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-2RS 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

DOOR NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES. BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.

Hardware Group No. 12

For use on Door #(s):
100F

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 2 | EA | CONT. HINGE | 112XY EPT TYPE AS REQ BY DOOR MFG | | US28 | IVE |
| 2 | EA | POWER TRANSFER | EPT10 CON | | 689 | VON |
| 1 | EA | KEYED REMOVABLE MULLION | KR4954 STAB | | 689 | VON |
| 2 | EA | ELEC PANIC HARDWARE | RX-QEL-98-EO-CON 24 VDC | | US26D | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | | 689 | VON |
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | | US26D | BES |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 18" O | | US32D -316 | IVE |
| 1 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | SURF. AUTO OPERATOR | 4642 CS 120 VAC | | 689 | LCN |
| 1 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 1 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 2 | EA | ACTUATOR PKG - WIRELESS | 8310-3857TW | | 630 | LCN |
| 2 | EA | WIRE HARNESS (FRAME) EPT TO POWER/CONTROLLER | CON-192P | | | SCH |
| 2 | EA | WIRE HARNESS (DOOR) EPT TO ELEC LOCK/EXIT | CON-XX (LENGTH AS REQUIRED) | | | SCH |
| 2 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-4RL 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

WEATHER STRIPPING BY ALUMINUM DOOR/FRAME MFG.

DOOR NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES.
ENTRY BY CARD READER RETRACTS LATCH ALLOWING DOOR TO BE PULLED OPEN. ENTRY BY KEY OVERRIDE.
ENTRY BY ADA OPERATOR AS PROGRAMMED BY ACCESS CONTROL SYSTEM.
BOTH EXIT DEVICES PROVIDED WITH ELECTRIC LATCH RETRACTION FOR PUSH/PULL OPERATION AS PROGRAMMED BY ACCESS CONTROL SYSTEM.
CARD READER AND ELECTRICAL WIRING BY SECURITY CONTRACTOR.

Hardware Group No. 13

For use on Door #(s):
101

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - STOREROOM | 45H-7-D-15R | | 626 | BES |
| 1 | EA | ELECTRIC STRIKE | 6211 FSE CON | | 630 | VON |
| 1 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 1 | EA | BLADE STOP SPACER | 4040XP-61 | | 689 | LCN |
| 1 | EA | WIRE HARNESS (FRAME) ELECTRIC STRIKE TO POWER/CONTROLLER | CON-192P | | | SCH |
| 1 | EA | DESK MOUNT BUTTON | 660-PB | | 628 | SCE |
| 1 | EA | DOOR POSITION SWITCH | 67-05 | | BLK | SCE |
| 1 | EA | RX SWITCH - MOTION SENSOR | SCANII 12/24 VDC | | BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 120/240 VAC | | | VON |
| 1 | EA | SET OF WIRING DIAGRAMS | | | | |

DOORS NORMALLY CLOSED, LATCHED AND SECURE. FREE EGRESS AT ALL TIMES.
ENTRY BY CARD READER RELEASES ELECTRIC STRIKE ALLOWING DOOR TO BE PULLED OPEN.
ENTRY BY KEY OVERRIDE.
ENTRY BY REMOTE PUSH BUTTON RELEASES ELECTRIC STRIKE ALLOWING DOOR TO BE PULLED OPEN.
CARDER READER AND ELECTRICAL WIRING BY SECURITY CONTRACTOR

Hardware Group No. 14 - Not Used

Hardware Group No. 15

For use on Door #(s):
102 103

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - OFFICE | 45H-7-AB-15R | | 622 | BES |
| 1 | EA | WALL STOP | WS406/407CVX | | US26D | IVE |

Hardware Group No. 16

For use on Door #(s):
101A

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 1 | EA | MORTISE LOCK - OFFICE | 45H-7-AB-15R | | 622 | BES |
| 1 | EA | CONC OH STOP | 100S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP EDA | | 689 | LCN |
| 1 | EA | PA MOUNTING PLATE | 4040XP-18PA | | 689 | LCN |
| 1 | EA | CUSH SHOE SUPPORT | 4040XP-30 | | 689 | LCN |

Hardware Group No. 17

For use on Door #(s):
104

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 6 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 2 | EA | MANUAL FLUSH BOLT | FB458 | | 626 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | | 626 | IVE |
| 1 | EA | MORTISE LOCK - STOREROOM | 45H-7-D-15R | | 626 | BES |
| 2 | EA | OH STOP | 90S | | 630 | GLY |
| 1 | EA | ASTRAAGAL - 1 PIECE | 322A | | A | ZER |
| 2 | EA | SILENCER | SR64 | | GRY | IVE |

Hardware Group No. 18

For use on Door #(s):
30

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | | FINISH | MFR |
|---|---|---|---|---|---|---|
| 6 | EA | HINGE | 5BB1HW 4.5 X 4.5 | | 652 | IVE |
| 2 | EA | MANUAL FLUSH BOLT | FB458 | | 626 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | | 626 | IVE |
| 1 | EA | MORTISE LOCK - CLASSROM | 45H-7-R-15R | | 626 | BES |
| 1 | EA | OH STOP | 90S | | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP RW/62A | | 689 | LCN |
| 2 | EA | KICK PLATE | 8400 10" X 1" LDW B-CS | | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | | US26D | IVE |
| 2 | EA | SILENCER | SR64 | | GRY | IVE |

ASTRAGAL BY HOLLOW METAL DOOR MFG.
CLOSER TO BE MOUNTED ON ACTIVE LEAF.

Hardware Group No. 19

For use on Door #(s):
30A

Provide each RU door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 1 | EA | RIM/MORTISE CYLINDER | TYPE AS REQUIRED | US26D | BES |
| 1 | EA | BALANCE OF HARDWARE BY DOOR MFG/SUPPLIER | | | |

**END OF SECTION**

**SECTION 08 80 00**
**GLAZING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic films.

D. Glazing compounds.

### 1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

### 1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

I. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

L. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

N. ASTM F1233 - Standard Test Method for Security Glazing Materials And Systems; 2021.

O. GANA (GM) - GANA Glazing Manual; 2022.

P. GANA (SM) - GANA Sealant Manual; 2008.

Q. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.

R. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

S. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

T. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

U. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

V. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

### 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit, Glazing Unit, Plastic Sheet Glazing Unit, and Plastic Film Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units.

E. Certificate: Certify that products of this section meet or exceed specified requirements.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

### 1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

### 1.07 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Provide on-site glazing mock-up with the specified glazing components.

C. Locate where directed.

D. Mock-ups may not remain as part of the Work.

### 1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

### 1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Glass Fabricators:
   1. JE Berkowitz, LP: www.jeberkowitz.com
   2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   3. Viracon, Inc: www.viracon.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
   2. Guardian Glass, LLC: www.guardianglass.com/#sle.
   3. Pilkington North America Inc: www.pilkington.com/na/#sle.
   4. PPG Industries, Inc.: www.ppgideascapes.com
   5. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
   2. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.
   3. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

## 2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

## 2.04 GLAZING UNITS

A. Type I-1 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.
   5. Glazing Method: Dry glazing method, gasket glazing.

## 2.05 PLASTIC FILMS

A. Type F-2 - Safety and Security Plastic Film: Polyester type.
   1. Application: At all new glazing locations at Butterworth Elementary School.

2. Tensile Strength: Minimum of 32,000 psi when measured in accordance with ASTM D882.
3. Impact Resistance: Comply with ANSI Z97.1 and 16 CFR 1201 impact test requirements when applied to 1/8 inch thick annealed glass.
4. Break Strength: 255 lbs/in
5. Elongation at Break: 130%
6. Color: Clear.
7. Thickness Without Liner: 0.008 inch.
8. Provide full attachment system to attach glazing/film to frame system.
9. Location: Type E-2
10. Basis of Design: 3M Window Film; Product: Ultra 800: www.3M.com.

**2.06 GLAZING COMPOUNDS**

A. Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

C. Manufacturers:
1. Bostik Inc: www.bostik-us.com/#sle.
2. Dow Corning Corporation: www.dowcorning.com/construction/#sle.Dow Corning Corporation: www.dowcorning.com/construction/#sle.
3. Momentive Performance Materials, Inc: www.momentive.com/#sle.
4. Pecora Corporation: www.pecora.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

**2.07 ACCESSORIES**

A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
2. Thickness: As required for application.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; color black.

F. Glazing Clips: Manufacturer's standard type.

**PART 3 EXECUTION**

**3.01 VERIFICATION OF CONDITIONS**

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

**3.02 PREPARATION**

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

**3.03 INSTALLATION, GENERAL**

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

**3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

**3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)**

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

F. Carefully trim protruding tape with knife.

**3.06 FIELD QUALITY CONTROL**

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

### 3.07 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### 3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

### 3.09 SCHEDULES

A. Refer to Drawings.

**END OF SECTION 08 80 00**

**SECTION 09 05 61**
**COMMON WORK RESULTS FOR FLOORING PREPARATION**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.
   3. Thin-set ceramic tile and stone tile.
   4. Synthetic Sports Flooring.

B. Removal of existing floor coverings.

C. Preparation of existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

F. Patching compound.

G. Remedial floor coatings.

### 1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

### 1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

### 1.04 ADMINISTRATIVE REQUIREMENTS

### 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.

C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

D. Remedial Materials Product Data (if required): Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.

2. Certificate: Manufacturer's certification of compatibility with types of flooring applied over remedial product.
3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
4. Manufacturer's installation instructions.

E. Testing Agency's Report:
1. Description of areas tested; include floor plans and photographs if helpful.
2. Summary of conditions encountered.
3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Product data for recommended remedial coating.
7. Submit report not more than two business days after conclusion of testing.

F. Adhesive Bond and Compatibility Test Report.

G. Copy of RFCI (RWP).

**1.06 QUALITY ASSURANCE**

A. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

**1.08 FIELD CONDITIONS**

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.

2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
3. Products:
    a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
    b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
    c. LATICRETE International, Inc; SKIM LITE: www.laticrete.com/#sle.
    d. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
    e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating (if required) : Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Use product recommended by testing agency.

## PART 3 EXECUTION

### 3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    b. Removal of existing floor covering.
2. Preliminary cleaning.
3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Specified remediation, if required.
7. Patching, smoothing, and leveling, as required.
8. Other preparation specified.
9. Adhesive bond and compatibility test.
10. Protection.

B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive

for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### 3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

### 3.03 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

### 3.04 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

### 3.05 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

### 3.06 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

### 3.07 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

**3.08 ADHESIVE BOND AND COMPATIBILITY TESTING**

A. Comply with requirements and recommendations of floor covering manufacturer.

**3.09 APPLICATION OF REMEDIAL FLOOR COATING**

A. Comply with requirements and recommendations of coating manufacturer.

**3.10 APPLICATION OF REMEDIAL FLOOR TREATMENT**

A. Comply with requirements and recommendations of treatment manufacturer.

**3.11 PROTECTION**

A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION 09 05 61**

**SECTION 09 21 16**
**GYPSUM BOARD ASSEMBLIES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

### 1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

D. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

F. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).

G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

P. ASTM E413 - Classification for Rating Sound Insulation; 2022.

Q. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

## 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

## 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

## 1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

# PART 2 PRODUCTS

## 2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

## 2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
   2. MarinoWARE; ____: www.marinoware.com/#sle.
   3. Phillips Manufacturing Co; ____: www.phillipsmfg.com/#sle.
   4. SCAFCO Corporation; _____: www.scafco.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

## 2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG Corporation: www.usg.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required at all locations.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 1/2 inch.
   4. Mold-Resistant, Paper-Faced Products:
      a. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
      b. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
      c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
      d. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire-resistance-rated Type X, UL or WH listed.
   4. Thickness: 5/8 inch.
   5. Edges: Tapered.

**2.04 GYPSUM BOARD ACCESSORIES**

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness 2 inches.

B. Acoustical Shielding: Recycled ethylene vinyl acetate (EVA) sheet membrane with fiberglass facer; applied over gypsum board.
   1. Surface Burning Characteristics: Provide assemblies with Class I rating, when tested in accordance with ASTM E84.

C. Finishing Accessories: ASTM C1047, galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
   3. Products:
      a. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
      b. Stockton Products: www.stocktonproducts.com/#sle.
      c. Trim-tex, Inc: www.trim-tex.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Joint Materials: ASTM C475/C475M.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners.
   2. Joint Compound: Setting type, field-mixed.

E. Finishing Compound: Surface coat and primer, takes the place of skim coating.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

G. Adhesive for Attachment to Wood, ASTM C557:

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

### 3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

C. Blocking: Install wood blocking for support of:
   1. Framed openings.

### 3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

### 3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Installation on Wood Framing: For nonrated assemblies, install as follows:
   1. Single-Layer Applications: Adhesive application.

### 3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

### 3.06 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use fiberglass joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

### 3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### 3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

**END OF SECTION 09 21 16**

**SECTION 09 51 00**
**ACOUSTICAL CEILINGS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

### 1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

### 1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 6" by 6" inch in size illustrating material and finish of acoustical units.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

### 1.04 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### 1.05 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc; ____: www.armstrongceilings.com/#sle.
   2. Certainteed Architectural; ____: www.certainteed.com/ceilings-and-walls/#sle.
   3. USG Corporation; ____: www.usg.com/ceilings/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Suspension Systems:
   1. Same as for acoustical units.

### 2.02 ACOUSTICAL UNITS

A. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
   2. Size: 24 by 24 inches.
   3. Thickness: 3/4 inch.
   4. Panel Edge: Square.
   5. Suspension System: Exposed grid.
   6. Products:
      a. Armstrong World Industries, Inc; Fine Fissured: www.armstrongceilings.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

## 2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application. Provide at vestibule.

D. Perimeter Moldings: Same metal and finish as grid.
   1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

## 3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

## 3.03 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

F. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

G. Do not eccentrically load system or induce rotation of runners.

## 3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

F. Install hold-down clips on panels within 20 ft of an exterior door.

### 3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

### 3.06 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

**END OF SECTION 09 51 00**

**SECTION 09 65 00**
**RESILIENT FLOORING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

### 1.03 REFERENCE STANDARDS

A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers; 1998 (Reapproved 2023).

B. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.

C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

D. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.

E. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate floor patterns.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: _____ square feet of each type and color.
   3. Extra Wall Base: 20 linear feet of each type and color.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

## 1.07 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

# PART 2 PRODUCTS

## 2.01 TILE FLOORING

A. Vinyl Tile - Type LVT-1: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
   1. Manufacturers:
      a. Milliken Flooring; Lumenology 5mm: https://www.milliken.com/en-us/flooring
      b. Mohawk Group; Product: Chromascope C0159 - 960 Whispering Grey; www.mohawkgroup.com
      c. Substitutions: Not permitted.
   2. Minimum Requirements: Comply with ASTM F1700, Class III.
   3. Impact Insulation Class (IIC): 57, minimum, when floor-ceiling assembly tested in accordance with ASTM E492.
   4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648.
   5. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329.
   6. Plank Tile Size: As indicated on drawings.
   7. Wear Layer Thickness: 0.020 inch Minimum.
   8. Total Thickness: 0.10 inch.
   9. Pattern: Brick Ashlar.
   10. Color: As indicated on drawings.

## 2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; Style B, Cove.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
      b. Mannington Commercial: www.manningtoncommercial.com#sle.
      c. Roppe Corporation: www.roppe.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Height: 4 inches.
   3. Thickness: 0.125 inch.
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: As indicated on drawings.

## 2.03 ACCESSORIES

A. Moldings, Transition and Edge Strips: Same material as flooring.
   1. Manufacturers:
      a. Mannington Commercial; _____: www.manningtoncommercial.com#sle.
      b. Schluter-Systems; VinPro: www.schluter.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Filler for Coved Base: Plastic.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### 3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

### 3.03 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

### 3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

### 3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

### 3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION 09 65 00**

**SECTION 09 65 66**
**RESILIENT ATHLETIC FLOORING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Vinyl sheet flooring, adhesively installed.

B. Painted game lines.

### 1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

D. Section 09 65 00 - Resilient Flooring.

### 1.03 REFERENCE STANDARDS

A. ASTM D297 - Standard Test Methods for Rubber Products - Chemical Analysis; 2021.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, and layout, colors, and widths of game lines and equipment locations.

D. Selection Samples: Manufacturer's color charts for flooring materials specified and game line paints, indicating full range of colors and textures available.

E. Verification Samples: Actual flooring material specified, not less than 12 inch square, mounted on solid backing.
   1. Include samples of game lines, illustrating colors selected.

F. Manufacturer's Instructions: Indicate standard and special installation procedures.

G. Installer's qualification statement.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

### 1.07 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F for not less than 48 hours before the beginning of installation and for not

less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F or to go above 100 degrees F.

## PART 2 PRODUCTS

### 2.01 PREFORMED ATHLETIC FLOORING

A. Vinyl Sheet Flooring:
   1. Wearing Surface: Pure polyvinyl chloride, mechanically extruded and uniformly resilient material with uniform color throughout thickness.
   2. Underlayments: Provide per manufacturer's written instructions.
      a. Engineered Wood Panel Thickness: 3/4 inch.
      b. HPL Underlayment Thickness: 7 mm.
   3. Foamular Underlayment: Provide per manufacturer's written instructions.
      a. Material: Polyiso Board.
      b. Thickness: 1-1/2 inch.
   4. Sheet Thickness: Minimum 2 mm.
   5. Sheet Width: Minimum 78 inches.
   6. Sheet Lengths: As necessary to minimize transverse seams.
   7. Seaming Method: Welding with heat or chemical.
   8. Surface Texture: Embossed.
   9. Color: As selected from manufacturer's standard range.
   10. Game Lines: Paint as approved by manufacturer of vinyl sheet flooring.
   11. Top Coat: If required by manufacturer for additional UV protection, a clear polyurethane coating that protects game lines and wearing surface.
   12. Products:
      a. Basis of Design (Washington Elementary): Tarkett Sports Indoor; Lumaflex Compact 2.0 mm: https://www.tarkettsportsindoor.com/
      b. Basis of Design (Logan/ Butterworth Elementary): Tarkett Sports Indoor; Omnisports HPL 9: https://www.tarkettsportsindoor.com/
      c. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 ACCESSORIES

A. Leveling Compound: Latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.

B. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
   2. Follow moisture and alkalinity remediation procedures in Section 09 05 61.

### 3.02 PREPARATION

A. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.

B. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

C. Broom clean areas to receive athletic flooring immediately before beginning installation.

**3.03 INSTALLATION**

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Resilient Sheet Flooring:
   1. Unroll flooring and allow to relax before beginning installation.
   2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
   3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
   4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
   5. Weld seams using techniques and equipment recommended by manufacturer.
   6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
   7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

**3.04 CLEANING**

A. Clean flooring using methods recommended by manufacturer.

**3.05 PROTECTION**

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

**END OF SECTION 09 65 66**

**SECTION 09 67 00**
**FLUID-APPLIED FLOORING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Fluid-applied flooring and base.

### 1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

B. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

### 1.03 REFERENCE STANDARDS

A. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.

B. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2023.

C. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2019.

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

F. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available; and _____.

C. Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each floor material for each color specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

### 1.05 QUALITY ASSURANCE

### 1.06 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
   1. Number of Mock-Ups to be Prepared: One.
   2. Use same materials and methods for use in the work.
   3. Locate where directed.
   4. Minimum Size: 48 inches by 48 inches.

C. See Section 01 40 00 - Quality Requirements for additional requirements.

D. Obtain approval of mock-up by Architect before proceeding with work.

E. Approved mock-up may remain as part of the work.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

## 1.08 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Fluid-Applied Flooring:
   1. Basis of Design - Flake System Blend:
      a. Sherwin-Williams Company: General Polymers Brand; Deco Flake System
   2. Other Acceptable Manufacturers:
      a. Crossfield Products Corp; _____: www.crossfieldproducts.com/#sle.
      b. Key Resin Company; www.keyresin.com/#sle.
      c. Sika Corporation; www.sikafloorusa.com/#sle.
      d. Substitutions: See Section 01 60 00-Product Requirements.
   3. Sika Corporation; _____: www.sikafloorusa.com/#sle.

## 2.02 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring: Epoxy base coat(s), with broadcast aggregate.
   1. Aggregate: 1/8" Vinyl flakes.
   2. Top Coat: Polyurethane.
   3. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
   4. Texture: Slip resistant.
   5. Sheen: High gloss.
   6. Color: As selected by Architect.

## 2.03 ACCESSORIES

A. Base Caps: Zinc with projecting base of 1/8 inch; color as selected.

B. Cant Strips: Molded of flooring resin material.

C. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

D. Primer: Type recommended by fluid-applied flooring manufacturer.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.

### 3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

D. Apply primer to surfaces required by flooring manufacturer.

### 3.03 INSTALLATION - ACCESSORIES

A. Install cant strips at base of walls where flooring is to be extended up wall as base.

B. Install terminating cap strip at top of base; attach securely to wall substrate.

### 3.04 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness required by manufacturer.

C. Finish to smooth level surface.

D. Install flooring in recessed type floor access covers.

E. Cove at vertical surfaces.

### 3.05 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until fully cured.

**END OF SECTION 09 67 00**

**SECTION 09 68 13**
**TILE CARPETING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Removal of existing carpet tile.

### 1.02 RELATED REQUIREMENTS

A. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

### 1.03 REFERENCE STANDARDS

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Tile Carpeting, Type CPTT-1: Tufted, manufactured in one color dye lot.
   1. Basis of Design: : Wild Horizons GT366 manufactured by Mohawk Group.
   2. Color: 749 Gray Dogwood
   3. Tile Size: 12in x 36in. nominal.
   4. Gauge: 1/12
   5. Finished Pile Height: 0.115”
   6. Standard Backing: Ecoflex One

B. Tile Carpeting, Type WO-1: Walk-Off Tile, manufactured in one color dye lot.
   1. Basis of Design: Tuff Stuff II; Step Up II GT311 manufactured by Mohawk Group.
   2. Color: Cobalt

3. Tile Size: 24in x 24in. nominal.

## 2.02 ACCESSORIES

A. Edge Strips: Embossed aluminum, _____ color.

B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

## 3.02 PREPARATION

A. Remove existing carpet tile.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

## 3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

## 3.04 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Clean and vacuum carpet surfaces.

**END OF SECTION 09 68 13**

**SECTION 09 91 13**
**EXTERIOR PAINTING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.

B. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Floors, unless specifically indicated.
   7. Ceramic and other types of tiles.
   8. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   9. Glass.
   10. Concealed pipes, ducts, and conduits.

### 1.02 RELATED REQUIREMENTS

### 1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

C. SSPC-SP 2 - Hand Tool Cleaning; 2024.

D. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

### 1.06 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.

B. Provide door and frame assembly illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Mock-up may remain as part of the work.

### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

### 1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: _____.
2. Behr Paint Company: www.behr.com/#sle.
3. PPG Paints: www.ppgpaints.com/#sle.
4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Colors: As indicated in Color Schedule.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

**2.03 PAINT SYSTEMS - EXTERIOR**

A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal and hollow metal doors and frames.
1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
a. Products:
1) Behr Dynasty Exterior Semi-Gloss [No.5650].
2) Pittsburgh Paints Speedhide Exterior Latex, 6-900XI Series, Semi-Gloss. (MPI #11)
3) Sherwin-Williams Pro Industrial Acrylic, Semi-Gloss.
4) Substitutions: See Section 01 60 00 - Product Requirements

**2.04 PRIMERS**

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali-Resistant Water-Based Primer; MPI #3.
a. Products:
1) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer [No.436]. (MPI #3)
2) Pittsburgh Paints Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603XI. (MPI #3)
3) Sherwin-Williams Loxon Water Blocking Primer/Finish.
4) Substitutions: See Section 01 60 00 - Product Requirements

**2.05 ACCESSORY MATERIALS**

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.

**3.02 PREPARATION**

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.

G. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

H. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

**3.03 APPLICATION**

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**3.04 CLEANING**

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.05 PROTECTION**

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 91 13**

**SECTION 09 91 23**
**INTERIOR PAINTING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Marble, granite, slate, and other natural stones.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   9. Glass.
   10. Concealed pipes, ducts, and conduits.

### 1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

### 1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

C. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

### 1.06 MOCK-UP

A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.

B. Provide door and frame assembly illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Mock-up may remain as part of the work.

### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

### 1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:
1. Behr Paint Company: www.behr.com/#sle.
2. Pittsburgh Paints: www.ppgpaints.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.

**2.03 PAINT SYSTEMS - INTERIOR**

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry units, plaster, and uncoated steel.
1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
a. Concrete Block:
1) Low Odor - Zero VOC Finish
2) 1st Coat: S-W PrepRite® Block Filler, B25W25 (75-125 sq ft/gal).
3) 2nd Coat: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy Eg-Shel.
4) 3rd Coat: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy Eg-Shel.
b. Gypsum Board - Application: Ceilings:
1) Low Odor - Zero VOC Finish
2) 1st Coat: S-W ProMar 200 Zero VOC Latex Primer, B28W2600.
3) 2nd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B30-2600 Series.
(a) (4 mils wet, 1.6 mils dry per coat)
4) 3rd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B30-2600 Series.
(a) (4 mils wet, 1.6 mils dry per coat)
c.
1) Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
2) Eggshell: MPI gloss level 3; use this sheen at all locations.
3) Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
d. Primer: As recommended by top coat manufacturer for specific substrate.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors and door frames.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
a. Metal-Ferrous Metal:
1) Low Odor - Zero VOC Finish.
2) 1st Coat: S-W Pro Industrial Pro-Cryl Primer, B66-310 Series.
(a) (2-4 mils dry per coat)
3) 2nd Coat: S-W Pro Industrial Pre-Catalyzed Waterbased Semi-Gloss Epoxy.
(a) (4 mils wet, 1.6 mils dry per coat)
4) ) 3rd Coat: S-W Pro Industrial Pre-Catalyzed Waterbased Semi-Gloss Epoxy.
(a) (4 mils wet, 1.6 mils dry per coat)

**2.04 PRIMERS**

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Interior/Exterior Latex Block Filler; MPI #4.
a. Products:

1) Behr Pro Block Filler Primer [No.PR050]. (MPI #4)
2) Pittsburgh Paints Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI. (MPI #4)
3) Sherwin-Williams Loxon Block Surfacer. (MPI #4)
4) Substitutions: See Section 01 60 00 - Product Requirements

2. Interior Drywall Primer Sealer.
   a. Products:
      1) Behr Premium Plus Interior Drywall Primer and Sealer [No.73].
      2) KILZ PVA Drywall Primer [No.PX010].
      3) Pittsburgh Paints Speedhide Zero Interior Latex Sealer, 6-4900XI.
      4) Zinsser by Rust-Oleum Corporation Drywall Primer: www.rustoleum.com/#sle.
      5) Substitutions: See Section 01 60 00 - Product Requirements
3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
   a. Products:
      1) Pittsburgh Paints Multiprime Multi-Purpose Primer, 4160 Series. (MPI #79)
      2) Substitutions: See Section 01 60 00 - Product Requirements

**2.05 ACCESSORY MATERIALS**

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 percent.

**3.02 PREPARATION**

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Masonry:

F. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

**3.03 APPLICATION**

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**3.04 CLEANING**

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.05 PROTECTION**

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 91 23**

**SECTION 09 93 00**
**STAINING AND TRANSPARENT FINISHING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Field application of stains.

B. Field application of transparent finishes.

### 1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Stains and transparent finishes for concrete substrates.

### 1.03 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and catalog number, and general product category.
   2. MPI product number (e.g. MPI #33).
   3. Manufacturer's installation instructions.

C. Samples: Two samples on actual wood substrate to be finished, 4 by 8 inch in size, indicating selected colors and sheens for each system, with specified coats cascaded.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Manufacturer's Qualification Statement.

F. Maintenance Data: Submit data including finish schedule showing where each product, color, and finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years of documented experience.

B. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

### 1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Provide finishes from the same manufacturer to the greatest extent possible.

B. Transparent Finishes:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Stains:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

### 2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
   1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each finish material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.

### 2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood - Floors:
   1. 2 stain coatings.
   2. 2 top coat.
   3. Stain: Semi-transparent stain for wood; MPI #90.
      a. Basis of Design Products:
         1) Sherwin-Williams MinWax 250 VOC Oil Stain. (MPI #90)
         2) Substitutions: Section 01 60 00 - Product Requirements.
   4. Top Coat: Polyurethane varnish, high build.
      a. Basis of design products:
         1) Sherwin-Williams MinWax High Build Polyurethane, Satin.
         2) Substitutions: Section 01 60 00 - Product Requirements.

### 2.04 ACCESSORY MATERIALS

A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

B. Patching Material: Latex filler.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

### 3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall items removed prior to finishing.

### 3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 93 00**

**SECTION 10 11 00**
**VISUAL DISPLAY UNITS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Porcelain enamel steel markerboards.

B. Tackboards.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

### 1.03 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

B. ANSI A208.1 - American National Standard for Particleboard; 2022.

C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics; 2025.

H. PS 1 - Structural Plywood; 2023.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.

D. Samples: Color charts for selection of color and texture of porcelain enamel steel markerboard, tackboard, tackboard surface covering, and trim.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### 1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

## PART 2 PRODUCTS

### 2.01 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:
   1. Manufacturers:
      a. ASI Visual Display Products; Series 9800: www.asi-visualdisplayproducts.com/#sle.
      b. Claridge Products and Equipment, Inc; LCS Series - 3/4" Trim: www.claridgeproducts.com/#sle.
      c. Nelson Adams NACO: https://www.nelsonadamsnaco.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Color: White.
3. Steel Face Sheet Thickness: 28 gauge, 0.0149 inch.
4. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
5. Backing: Aluminum foil, laminated to core.
6. Height: 48 inches.
7. Length: As indicated on drawings.
8. Frame: Extruded aluminum , with concealed fasteners.
9. Frame Finish: Anodized, natural.
10. Accessories: Provide marker tray.

B. Tackboards: Fabric laminated to fiberboard.
1. Manufacturers:
2. Fabric: Vinyl-coated fabric.
3. Color: As selected from manufacturer's full range.
4. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
6. Height: 12 inches.
7. Length: To match markerboard lengths indicated on drawings.
8. Frame: Extruded aluminum , with concealed fasteners.
9. Frame Profile: As indicated on drawings.
10. Frame Finish: Anodized, natural.
11. Location: To be mounted above all markerboards.

## 2.02 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Vinyl-Coated Fabric: ASTM F793 Category VI.

C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.

D. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

E. Adhesives: Type used by manufacturer.

## 2.03 ACCESSORIES

A. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

B. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.

C. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near marker rail.

D. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.

E. Mounting Brackets: Concealed.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

## 3.02 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.

B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

**3.03 INSTALLATION**

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Butt Joints: Install with tight hairline joints.

**3.04 CLEANING**

A. Clean board surfaces in accordance with manufacturer's instructions.

B. Cover with protective cover, taped to frame.

C. Remove temporary protective cover at Date of Substantial Completion.

**END OF SECTION 10 11 00**

**SECTION 10 14 23**
**PANEL SIGNAGE**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Panel signage.

### 1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

### 1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.

F. Verification Samples: Submit samples showing colors, materials, and finishes specified.

G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

H. Manufacturer's qualification statement.

### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

### 1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Panel Signage:
   1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
   2. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
   3. Inpro Corporation: www.inprocorp.com/#sle.
   4. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

### 2.03 PANEL SIGNAGE

A. Panel Signage:
   1. Application: Room and door signs.
   2. Description: Flat signs with injection molded panel media, tactile characters.
   3. Sign Size: 4 inches by 6 inches.
   4. Total Thickness: 1/8 inch.
   5. Color and Font, unless otherwise indicated:
      a. Character Font: Helvetica, Arial, or other sans serif font.
      b. Character Case: Upper and lower case (title case).
      c. Background Color: As scheduled.
      d. Character Color: Contrasting color.
   6. Material: One-piece injection molded acrylic plastic with raised letters and braille.
   7. Profile: Flat panel without frame.
   8. Tactile Letters: Raised 1/32 inch minimum.
   9. Braille: Grade II, ADA-compliant.
   10. One-Sided Wall Mounting: Tape adhesive.

### 2.04 SIGNAGE APPLICATIONS

A. Room and Door Signs:
   1. Classroom and Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.
   2. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings, and braille.
   3. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

### 2.05 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until substantial completion; repair or replace damaged items.

### 3.03 SCHEDULE

A. Provide room signage for all rooms at Butterworth Elementary School.

**END OF SECTION 10 14 23**

**SECTION 10 51 13**
**METAL LOCKERS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Metal lockers.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.

### 1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

D. Samples: Submit two samples 3 by 6 inches in size showing color and finish of metal locker material.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Metal Lockers:
   1. ASI Storage Solutions; _____: www.asi-storage.com/#sle.
   2. List Industries, Inc; ____: www.listindustries.com/#sle.
   3. Lyon Workspace Products; ____: www.lyonworkspace.com/#sle.
   4. Penco Products, Inc; ____: www.pencoproducts.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 LOCKER APPLICATIONS

A. Student Lockers: Metal lockers, recessed mounted.
   1. Width: 18 inches.
   2. Depth: 12 inches.
   3. Height: 54 inches.
   4. Configuration: Two tier.
   5. Fittings: Size and configuration as indicated on drawings.
      a. Hooks: Three single prong.
   6. Ventilation: Louvers at top and bottom of door panel.
   7. Locking: Padlock hasps, for padlocks provided by Owner.
   8. Color: To be selected from manufacturer's full range by Architect.

### 2.03 METAL LOCKERS

A. Locker Case Construction:
   1. Standard-Duty, Fully Assembled Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
      a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:

1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
2) Body and Shelves: 24 gauge, 0.0239 inch.
3) Backs: 24 gauge, 0.0239 inch.

b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
c. Where ends or sides are exposed, provide flush panel closures.
d. Provide filler strips where required, securely attached to lockers.

B. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
2. Form recess for operating handle and locking device.

C. Latches and Door Handles: Manufacturer's standard.

D. Hinges: Continuous piano hinge with powder coat finish to match locker color.

E. Trim: 20 gauge, 0.0359 inch. Provide 3" trim around existing recessed opening to match profile and size of existing trim. Color to match locker color.

F. Coat Hooks: Stainless steel or zinc-plated steel.

G. Number Plates: Provide oval shaped aluminum plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.

H. Locks: Locker manufacturer's standard type indicated in Applications article above.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and surrounding trim.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

### 3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

**END OF SECTION 10 51 13**

## SECTION 10 56 17
## WALL MOUNTED STANDARDS AND SHELVING

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Steel shelf standards, brackets, and accessories.

B. Steel shelf support brackets.

C. Shelves.

D. See drawings for locations and configurations.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for attachment of standards.

B. Section 09 21 16 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

### 1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products under cover and elevated above grade.

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

### PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Shelving:
   1. Magnuson Group; Villa Hook Wall Rack (WK01A-ST) : www.magnusongroup.com.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 COMPONENTS

A. Shelves: One shelf consisting of four 3/4-inch square, 18-gauge power coated steel bars.

B. Wall Mounts: 16-gauge formed steel u-channels which allow for shelf height adjustment.

C. Brackets: 18-gauge die formed steel, welded box construction.

D. Hooks: 14-gauge die formed steel, triple prong, vinyl coated. Provide two hooks every nine inches mounted on second and fourth tubes.

E. Finishes: Colors to be selected from the Manufacturer's standard line of colors for powder coating.

F. Lengths: As indicated on the drawings.

G. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount standards or brackets to solid backing capable of supporting intended loads.

C. Install brackets, shelving, and accessories.

### 3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 10 56 17**

**SECTION 11 66 23**
**GYMNASIUM EQUIPMENT**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Basketball backboards, goals, and support framing.

B. Floor sleeves for net and goal posts.

C. Wall mounted protection pads.

D. Volleyball nets and posts.

### 1.02 RELATED REQUIREMENTS

A. Section 09 65 66 - Resilient Athletic Flooring: Gymnasium flooring.

### 1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
   1. Manufacturer's installation instructions.

C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gauge of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.

D. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors.

E. Operating and maintenance data for each operating equipment item.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and approved by manufacturer.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.

B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.

C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

### 1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Gymnasium Equipment:
   1. Draper, Inc; _____: www.draperinc.com/#sle.

2. Performance Sports Systems; _____: www.perfsports.com/#sle.
3. Porter Athletic Equipment Company; _____: www.porterathletic.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 GENERAL REQUIREMENTS**

A. See drawings for sizes and locations, unless noted otherwise.

B. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.

C. Hardware: Heavy duty steel hardware, as recommended by manufacturer.

D. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M, using certified welders.

**2.03 BASKETBALL**

A. Basketball System: Backstop assembly, backboard, and goal.
1. Manufacturers:
a. Draper, Inc; _____: www.draperinc.com/#sle.
b. IPI by Bison, Inc; _____: www.ipibybison.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall-Mounted Backstop Assemblies: Wall-mounted steel frame assembly capable of mounting both rectangular and fan-shaped backboards.
1. Framing: Stationary and side-folding framing.
2. Folding Control System at Washington Elementary School: Manual winch with safety catch and automatic reset.
3. Height Adjuster: Raises or lowers assembly by 2 feet to adjust goal height.
a. Height Control System: Manual winch.
b. Basis of Design:
1) Rectangular Backboards: Draper, Inc.; Manual Height Adjuster - 503092: www.draperinc.com/#sle.
2) Fan Backboards: Draper, Inc.; Manual Height Adjuster - 503094:
4. Framing Color: Manufacturer's standard.
5. Basis of Design:
a. Washington Elementary - Rectangu:
1) Main Hoops: Draper, Inc; Wall Mounted Side-Folding Basketball Backstop - DGW: www.draperinc.com/#sle.
2) Side Hoops: Draper, Inc; Stationary Wall Mounted Basketball Backstop - SW: www.draperinc.com/#sle.
b. Logan Elementary - Fan Backboards:
1) Main Hoops: Draper, Inc; Stationary Wall Mounted Basketball Backstop - SW: www.draperinc.com/#sle.
c. Butterworth Elementary - Fan Backboards:
1) Main Hoops: Draper, Inc; Stationary Wall Mounted Basketball Backstop - SW: www.draperinc.com/#sle.

C. Backboards: Tempered glass, rectangular shaped.
1. Frame: Clear anodized aluminum w/ non-glare finish, steel mounting.
2. Provide conversion frame, mountable on both assemblies designed for fan shaped backboards and assemblies designed for rectangular backboards.
3. Markings: Integrally manufactured.
4. Provide safety padding for bottom edge of backboard.
5. Provide mounting kit. New backboards to be installed on existing backboard support system. Contractor to field verify connection points to new backboard system for complete install.
6. Color: Manufacturer's standard.
7. Basis of Design:

a. Washington Elementary: Draper, Inc.; Rectangular Glass 72" x 42" Basketball Backboard - 503136: www.draperinc.com/#sle.
b. Logan Elementary: Draper, Inc.; Fan Glass 54" x 39" Basketball Backboard
c. Butterworth Elementary: Drape, Inc.; Fan Glass 54" x 39" Basketball Backboard

D. Goals: Steel rim, mounted to backboard, with attached nylon net; complete with mounting hardware.
1. Net Attachment Device: Tube-tie.
2. Finish: Powder coat orange.

**2.04 FLOOR-MOUNTED EQUIPMENT**

A. Volley Ball Nets and Posts: One court system of adjustable posts, net, and tensioning winch meeting requirements for FIVB, USA Volleyball, NCAA and NFHS competition requirements.
1. Posts: 3-1/2 inch O.D. schedule 80 aluminum tube with 1 inch height adjustments between 42 and 96 inches.
2. Net: 4 inch square #36 nylon cord with vinyl coated polyester hem, double stitched around the perimeter.
3. Tensioning Winch: Manual crank heavy duty, self-locking worm gear mechanism.
4. Protective Pads: Polyethylene foam covered with polyester reinforced vinyl fabric.
5. Manufacturers:
a. Draper, Inc; _____: www.draperinc.com/#sle.
b. IPI by Bison, Inc; VB1000NS Centerline Aluminum: www.ipibybison.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Floor Sleeves for Posts: Metal sleeve, with latch cover, cast into concrete subfloor to hold poles for nets and goals; installed flush with finish floor surface.
1. Latch Cover: Brass, round; tamper resistant lock with key.
2. Sleeve: Aluminum.
3. Depth of Sleeve: 9 inches from floor surface to bottom, including latch cover.

**2.05 WALL PADDING**

A. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
1. Covering: Vinyl-coated polyester fabric, mildew and rot resistant; stapled to back of board.
a. Color: As selected from manufacturer's standard range.
b. Texture: Embossed leather-look.
c. Fabric Weight: 14 oz/sq yd, minimum.
2. Foam: Soft, urethane or polyurethane, with 3.5 pcf nominal density.
3. Foam Thickness: 2 inches.
4. Backing Board: Plywood.
5. Mounting: Removable; Z-clips fixed to wall and to padding.
6. Manufacturers:
a. Draper, Inc; _____: www.draperinc.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Specially Shaped Padding: Same construction as standard padding; custom fabricate to fit irregularly shaped members, areas, and protrusions in gymnasium as indicated; provide padding for:
1. Wall corners.
2. Stage corners.
3. Stage storage doors, custom cut to match hand holes/handle locations and lock locations.
4. Around existing ductwork at Butterworth Elementary School.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.

B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.

C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.

### 3.02 INSTALLATION

A. Install in accordance with Contract Documents and manufacturer's instructions.

B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.

C. Install equipment rigid, straight, plumb, and level.

D. Secure equipment with manufacturer's recommended anchoring devices.

E. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.

F. Separate dissimilar metals to prevent electrolytic corrosion.

### 3.03 ADJUSTING

A. Verify proper placement of equipment.

B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.

### 3.04 CLEANING

A. Remove masking or protective covering from finished surfaces.

B. Clean equipment in accordance with manufacturer's recommendations.

### 3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Replace damaged products before Date of Substantial Completion.

**END OF SECTION 11 66 23**

**SECTION 12 24 00**
**WINDOW SHADES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Interior manual roller shades.

### 1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

### 1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

B. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

### 1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

C. Selection Samples: Include fabric samples in full range of available colors and patterns.

D. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

### 1.07 FIELD CONDITIONS

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

### 1.08 WARRANTY

A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Fabric: One year.
   3. Aluminum and Steel Coatings: One year.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
   2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
   3. Inpro WT; H200 SoloMount® Clutch Shade: https://inpro-shades.com/.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Basis of Design: H200 SoloMount® Clutch Shade.
   2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Ceiling mounted.
      d. Size: As indicated on drawings.
   3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
   4. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
   5. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
   6. Manual Operation for Interior Shades:
      a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
      b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
      c. Chain Retainer:
         1) Chain tensioning device complying with WCMA A100.1.
   7. Accessories:
      a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
         1) Profile: Square.
      b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.

### 2.03 SHADE FABRIC

A. Fabric for Room-Darkening Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:

a. Mermet Corporation; Sparta Twilight - 0%: www.mermetusa.com/#sle.
b. Phifer, Inc; Style 7000 Blackout: www.phifer.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Material: Vinyl coated polyester.
3. Color: As selected by Architect from manufacturer's full range of colors.
4. Fabrication:
   a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
   b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
   c. Battens: Full width of shade, enclose in welded shade fabric pocket.

**2.04 ROLLER SHADE FABRICATION**

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
   3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

**3.02 PREPARATION**

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

**3.03 INSTALLATION**

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

**3.04 CLEANING**

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

**3.05 PROTECTION**

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

**END OF SECTION 12 24 00**

**SECTION 12 36 00**
**COUNTERTOPS**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

### 1.02 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

G. PS 1 - Structural Plywood; 2023.

### 1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

G. Installer's qualification statement.

H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

### 1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

B. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### 1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet, Type ___: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
      a. Manufacturers:
         1) Formica Corporation; _____: www.formica.com/#sle.
         2) Panolam Industries International, Inc; _____: www.panolam.com/#sle.
         3) Wilsonart; _____: www.wilsonart.com/#sle.
         4) Substitutions: See Section 01 60 00 - Product Requirements.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Surface Color and Pattern: As indicated on drawings.
   2. Exposed Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch thick with raised radiused edge, integral coved backsplash with radiused top edge.
   3. Back and End Splashes: Same material, same construction.

C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Dupont; _____: www.corian.com/#sle.
         2) Wilsonart; _____: www.wilsonart.com/#sle.
         3) Substitutions: See Section 01 60 00 - Product Requirements.
      b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
   5. Skirts: As indicated on drawings.
   6. Fabricate in accordance with manufacturer's standard requirements.

### 2.02 MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.
   2. Provide sustainably harvested wood, certified or labeled; see Section 01 60 00 - Product Requirements.
   3. Provide wood harvested within a 500 mile radius of the project site.

B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

D. Joint Sealant: Mildew-resistant silicone sealant, white.

## 2.03 ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
   3. Color: Black.
   4. Products:
      a. Centerline Brackets; Front Mounting Plus Countertop Support: www.countertopbracket.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

## 3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

## 3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Seal joint between back/end splashes and vertical surfaces.

## 3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

**3.05 CLEANING**

**3.06 PROTECTION**

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 12 36 00**

**SECTION 22 00 00**

**BASIC PLUMBING MATERIALS AND METHODS**

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Division 1 – General Acoustic Considerations – Definitions including:
   1. Acoustically Isolated Construction (AIC)
   2. Acoustically Sensitive Room (ASR)
   3. Noise Producing Room (NPR)

B. Division 9 – Joint Sealants

C. Division 22 – Vibration and Seismic Controls for Plumbing Systems

### 1.02 SUMMARY

A. Provide acoustical wall, floor, and ceiling penetrations as specified herein and as shown on the Contract Drawings. Verify all dimensions and requirements and coordinate with other trades as necessary to complete the work on schedule.

### 1.03 SUBMITTALS

A. Provide complete submittal including the following:
   1. Manufacturer cut sheets for all products.
      a. Provide for approval a list of alternative products proposed for use to achieve the requirements for airtight seal and no rigid connection between the pipe and the penetrated construction.

B. Shop Drawings: Provide shop drawings for all Penetration Sleeve Assemblies not made by a pre-approved manufacturer listed herein showing the use of alternative products to achieve an airtight closure and no rigid connection between the pipe and the penetrated construction. Additionally, include a narrative for approval which describes specific construction sequencing associated with Alternative Penetration Sleeve Assemblies that will be implemented for:
   1. Conditions when the penetrating pipe is installed prior to the future wall, floor, or ceiling construction.
   2. Conditions when the penetrating pipe is installed following construction of wall, floor, or ceiling elements.

C. Samples: Provide sample of sleeve construction, complete with sample pipe, to Architect, Mechanical Engineer, and Acoustic Consultant if product is not made by a pre-approved manufacturer listed herein.

## PART 2 - PRODUCTS

### 2.01 APPROVED MANUFACTURERS

A. Mason Industries (Mason), Hauppauge, NY – www.mason-ind.com

B. Kinetics Noise Control (Kinetics), Dublin, OH – www.kineticsnoise.com

C. Amber-Booth Company (ABC), Houston, TX – www.amberbooth.com

D. Vibration Mountings & Controls, Inc. (VMC), Bloomingdale, NJ – www.thevmcgroup.com

E. Armacell LLC (Armacell), Mebane, NC – www.armacell.com

F. Owens Corning (OC), Toledo, OH – www.owenscorning.com

G. Anvil International (Anvil), Exeter, NH – www.anvilintl.com

H. Johns Manville (JM), Denver, CO – www.specjm.com

I. Link-Seal, GPT Inc., Houston, TX – www.linkseal.com

**2.02 DESCRIPTION OF PRODUCTS**

A. Resilient Penetration Sleeves for Pipes

1. Where specified, resilient pipe penetrations shall be sleeved to avoid rigid connection between the building structure and the penetrating element.
2. Sleeve assembly shall consist of 1/2 inch (13mm) to 3/4 inch (19mm) formed closed cell neoprene foam or semi-rigid glass fiber liner with a metal surround. Inner diameter of sleeve assembly shall match the outer diameter of the associated pipe. Sleeve assembly may be split to allow it to be clamped once the pipe is installed.
3. Acceptable products:
   a. SWS Split Acoustical Wall Seal (Mason)
   b. NSW Sleeve (ABC)
   c. VCS Sleeve (VMC)
   d. Approved alternative products which follow the execution requirements identified within this specification section.

B. Alternative Penetration Sleeve Assembly

1. Where specified, resilient pipe penetrations shall be sleeved to avoid rigid connection between the building structure and the penetrating element.
2. Alternative Penetration Sleeve Assembly shall consist of a formed closed cell neoprene foam or semi-rigid glass fiber liner with a steel surround. Inner diameter of sleeve assembly shall match the outer diameter of the associated pipe. Sleeve assembly may be split to allow it to be clamped once the pipe is installed.
   a. Liner shall be a minimum 1/2 inch (13mm) thick with density of 6 to 10 pounds per cubic foot (96 to 160 kg/$m^3$)
   b. Surround shall be minimum 22 gauge steel. Surround may be split to allow it to be clamped once the pipe is installed.
3. Acceptable products (Metal Surround):
   a. Roundup Pipe Insulation Saddles (Buckaroos )
   b. Pipe Saddles (Anvil)
4. Acceptable products (Liner):
   a. Armaflex (Armacell)
   b. Micro-Lok (JM)
   c. Approved Equivalent

C. Perimeter Isolation Board

1. Where specified, group penetrations shall be sleeved using a 7 to 10 pound per cubic foot (112 to 160 kg/$m^3$) semi-rigid fiber or foam board.
2. Acceptable products:
   a. P7 (Mason)
   b. PIB (Kinetics)
   c. FIBERGLAS Type 707 (Owens Corning)
   d. Approved equivalent

## PART 3 - EXECUTION

### 3.01 GENERAL

A. The Contractor shall notify the Architect and the Acoustics Consultant prior to the installation of millwork, walls, ceilings, or other requirements which would obscure visual inspection of these acoustical products and will provide these parties with an opportunity to review the condition of the mounts prior to any such construction.

### 3.02 INSTALLATION

A. Piping Installation, General

1. All piping that cross the Extent of AIC shall be supported on vibration isolators for a distance of 8 feet (2.5m) measured linearly along the penetrating element.
2. Vibration isolate piping that is connected to vibration isolated equipment, as per Division 22 “Vibration and Seismic Control for Plumbing Systems”.
3. Coordinate locations of pipe penetrations that require sleeves prior to installing pipe to ensure sleeves are installed with the pipe. Installer shall be liable for any additional cost due to revision work or product changes due to sleeves not being initially provided.

B. Pipe Penetrations at Acoustic Applications:

1. Penetration Type A: Resilient and Airtight Penetration.
   a. Type A Penetrations are required for all:
      i. Acoustically Sensitive Rooms with a background noise level of RC-30 or less.
      ii. Penetrations through walls or slabs crossing and within 8 feet (2.5m) crossing of Acoustically Isolated Construction.
      iii. Penetrations through walls, floors, or ceilings of Noise Producing Rooms.
      iv. Wall, floor, or ceiling penetrations within 30 feet (9m) of a connection to vibration isolated equipment.
   b. Type A Penetrations shall be installed as follows, providing an airtight and resilient penetration:
      i. Wall, floor, or ceiling openings for Type A penetrations shall be oversized and sleeved to provide an inner diameter 1 to 2 inches (25 to 50mm) greater than the outside dimension of the sleeve or penetrating element.
      ii. The penetrating element shall be centered in the opening and shall not contact the wall, floor, or ceiling, even after filling.
      iii. The resulting gap shall be packed with glass fiber packing material and foam backer rod on both sides of the wall, floor, or ceiling.
      iv. The gap shall be caulked to an airtight seal using permanently flexible acoustical sealant on both sides of the wall, floor, or ceiling.
2. Penetration Type B: Fire Rated Resilient and Airtight Penetration.
   a. Where the use of Firestop is required in the conditions noted above, the packing materials and sealant indicated for Type A penetrations may be replaced with an approved permanently flexible Firestop sealant, creating a resilient and airtight penetration that is also compliant with fire code.
   b. In locations not common to Acoustically Sensitive Rooms requiring airtight and resilient penetrations of multiple pipes passing through a wall, floor, or ceiling, it is acceptable to utilize the penetration Type B detail for multiple pipes, as shown on the Contract Drawings.

3. Penetration Type C: Airtight Penetration
   a. Pipe penetrations of walls, floors, and ceilings of Acoustically Sensitive Rooms which do not meet the conditions for Type A or B penetrations shall utilize Type C Penetrations. Requirements for CMU, Concrete, Gypsum Board, or other walls are typical for both sides of the wall.
   b. CMU or Concrete walls, floors, and ceilings: Penetrations shall be grouted and caulked into the structure as follows, forming an airtight penetration:
      i. Oversize penetration to provide an inner diameter 1 to 2 inches (25 to 50mm) greater than the outside dimension of the penetrating element.
      ii. Before grout has set, rake a groove around the penetrating element on each side of the wall or slab.
      iii. The groove shall be 1/2 inch (13mm) wide and 1/2 inch (13mm) deep.
      iv. After grout has set, fill the groove full depth with permanently flexible acoustical sealant.
   c. Gypsum and wood walls, floors, and ceilings: Penetrations shall be mudded or caulked as follows, forming an airtight penetration:
      i. Mud all gaps between gypsum wallboard and penetrating element using joint compound.
      ii. After joint compound has set, caulk all gaps to an airtight seal using approved permanently flexible acoustical sealant.

**3.03 PROTECTION**

A. Products that would be exposed to the weather shall be wrapped in temporary protective plastic or other weather-tight coating until building is weather tight.

**END OF SECTION**

## SECTION 22 05 16

## EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
1. Rubber union connector packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Metal-bellows packless expansion joints.
4. Externally pressurized metal-bellows packless expansion joints.
5. Rubber packless expansion joints.
6. Grooved-joint expansion joints.
7. Alignment guides and anchors.
8. Pipe loops and swing connections.

#### 1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

#### 1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

#### 1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

#### 1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

#### 2.02 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints RUEJ-01 :
1. Material: Twin reinforced-rubber spheres with external restraining cables.
2. Minimum Pressure Rating: 150 psig at 170 deg F (1035 kPa at 77 deg C) , unless otherwise indicated.

3. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints FHEJ-01 :
   1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
   2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
   3. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
      a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
      b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.
   4. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.
   5. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.
   6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged welded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.
   7. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon-steel fittings with flanged welded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.
   8. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged welded end connections.
      a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.

C. Metal-Bellows Packless Expansion Joints MBEJ-01 :
   1. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
   2. Type: Circular, corrugated bellows with external tie rods.

3. Minimum Pressure Rating: 150 psig (1035 kPa) 175 psig (1200 kPa) 200 psig (1379 kPa) , unless otherwise indicated.
4. Configuration: Single joint Single joint with base and double joint with base class(es), unless otherwise indicated.
5. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded.
    c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.
6. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
    a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
    b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged Welded.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints EPEJ-01 :
1. Minimum Pressure Rating: 150 psig (1035 kPa) 200 psig (1379 kPa) 300 psig (2068 kPa) , unless otherwise indicated.
2. Description:
    a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
    b. Carbon-steel housing.
    c. Drain plugs and lifting lug for NPS 3 (DN 80) and larger.
    d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
    e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
    f. Joint Axial Movement: 4 inches (100 mm) 6 inches (150 mm) 8 inches (200 mm) <Insert compression limit> of compression and 0.75 inch (19 mm) 1 inch (25 mm) 2 inches (50 mm) <Insert extension limit> of extension.
3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

E. Rubber Packless Expansion Joints REJ-01 :
1. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
2. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
3. Arch Type: Single or multiple arches with external control rods.
4. Spherical Type: Single or multiple spheres with external control rods.
5. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C) .
6. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C) .
7. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C) .
8. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber Chlorosulfonyl-polyethylene rubber Ethylene-propylene-diene terpolymer rubber .
9. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N Chlorosulfonated polyethylene synthetic rubber .
10. Material for Water: Butyl rubber Buna-N Chlorosulfonated polyethylene synthetic rubber Chlorosulfonyl-polyethylene rubber Ethylene-propylene-diene terpolymer rubber Natural rubber.
11. End Connections: Full-faced, integral steel flanges with steel retaining rings.

## 2.03 GROOVED-JOINT EXPANSION JOINTS

A. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

B. Standard: AWWA C606, for grooved joints.

C. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

D. Couplings: Five Seven 10 12 , flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

## 2.04 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides AG-01 :
   1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:
   1. Steel Shapes and Plates: ASTM A 36/A 36M.
   2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
   3. Washers: ASTM F 844, steel, plain, flat washers.
   4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Stud: Threaded, zinc-coated carbon steel.
      b. Expansion Plug: Zinc-coated steel.
      c. Washer and Nut: Zinc-coated steel.
   5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
      b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
      c. Washer and Nut: Zinc-coated steel.

# PART 3 EXECUTION

## 3.01 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

## 3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

### 3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
   1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
   1. Anchor Attachment to Steel Structural Members: Attach by welding.
   2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION**

## SECTION 22 05 17

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

#### 1.03 ACTION SUBMITTALS

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

### PART 2 PRODUCTS

#### 2.01 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 (0.6-mm) 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.

#### 2.02 STACK-SLEEVE FITTINGS

A. 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.

#### 2.03 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel Plastic Stainless steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

#### 2.04 SLEEVE-SEAL FITTINGS

A. 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.

## 2.05 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 (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

# PART 3 EXECUTION

## 3.01 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 (25-mm) 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 (50 mm) 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 (6.4-mm) 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 Section 079200 "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 Section 078413 "Penetration Firestopping."

## 3.02 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 (6.4-mm) 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 Section 076200 "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) 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 Section 078413 "Penetration Firestopping."

## 3.03 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.

## 3.04 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.

## 3.05 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 (DN 150) : Cast-iron wall sleeves Galvanized-steel wall sleeves Galvanized-steel-pipe sleeves Sleeve-seal fittings .
    b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves Galvanized-steel wall sleeves Galvanized-steel-pipe sleeves .
2. Exterior Concrete Walls below Grade:
    a. Piping Smaller Than NPS 6 (DN 150) : Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system Sleeve-seal fittings .
        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system .
        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
    a. Piping Smaller Than NPS 6 (DN 150) : Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system Sleeve-seal fittings .
        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system Galvanized-steel-pipe sleeves .
        1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
    a. Piping Smaller Than NPS 6 (DN 150) : Galvanized-steel-pipe sleeves PVC-pipe sleeves Stack-sleeve fittings Sleeve-seal fittings Molded-PE or -PP sleeves Molded-PVC sleeves .
    b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves PVC-pipe sleeves Stack-sleeve fittings .
5. Interior Partitions:

a. Piping Smaller Than NPS 6 (DN 150) : Galvanized-steel-pipe sleeves PVC-pipe sleeves .
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves .

**END OF SECTION**

## SECTION 22 05 18
## ESCUTCHEONS FOR PLUMBING PIPING

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

### 1.03 ACTION SUBMITTALS

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

### PART 2 PRODUCTS

### 2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass 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 and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

### 2.02 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

### 3.01 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 or split-casting brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

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 or exposed-rivet 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 or exposed-rivet 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 or exposed-rivet hinge.
g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated rough-brass finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated rough-brass finish.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet 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.

**3.02 FIELD QUALITY CONTROL**

A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

## SECTION 22 05 19

## METERS AND GAGES FOR PLUMBING PIPING

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

### 1.03 ACTION SUBMITTALS

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

### 1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

### 1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 PRODUCTS

### 2.01 BIMETALLIC-ACTUATED THERMOMETERS

A. Standard: ASME B40.200.

B. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) 5-inch (127-mm) nominal diameter.

C. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C) deg F and deg C.

D. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom , with unified-inch screw threads.

E. Connector Size: 1/2 inch (13 mm) , with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

G. Window: Plain glass or plastic .

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 1.5 percent of scale range.

### 2.02 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel ; 4-1/2-inch (114-mm) 5-inch (127-mm) 6-inch (152-mm) nominal diameter.

3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass or plastic .
8. Ring: Metal Stainless steel .
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, plastic ; 4-1/2-inch (114-mm) 5-inch (127-mm) 6-inch (152-mm) nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass or plastic .
8. Ring: Metal or plastic .
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter with back front flange and holes for panel mounting.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass or plastic .
8. Ring: Metal Stainless steel .
9. Connector Type(s): Union joint, back bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, plastic ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter with back front flange and holes for panel mounting.

3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass or plastic .
8. Ring: Metal or plastic .
9. Connector Type(s): Union joint, threaded, back bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

**2.03 LIQUID-IN-GLASS THERMOMETERS**

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Cast aluminum ; 6-inch (152-mm) nominal size.
3. Case Form: Back angle Straight unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Plastic ; 6-inch (152-mm) nominal size.
3. Case Form: Back angle Straight unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Cast aluminum ; 7-inch (178-mm) 9-inch (229-mm) nominal size unless otherwise indicated.
3. Case Form: Adjustable angle Back angle Straight <Insert form> unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Window: Glass or plastic .
7. Stem: Aluminum and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.

9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Plastic ; 7-inch (178-mm) 9-inch (229-mm) nominal size unless otherwise indicated.
3. Case Form: Adjustable angle Back angle Straight <Insert form> unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
6. Window: Glass or plastic .
7. Stem: Aluminum Brass Stainless steel Aluminum, brass, or stainless steel and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.04 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:
1. Case: Plastic Metal ; 7-inch (178-mm) 9-inch (229-mm) nominal size unless otherwise indicated.
2. Scale(s): Deg F (Deg C) Deg F and deg C.
3. Case Form: Adjustable angle <Insert form>.
4. Connector: 1-1/4 inches (32 mm) , with ASME B1.1 screw threads.
5. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F (1 deg C).

B. Remote-Mounted, Light-Activated Thermometers:
1. Case: Plastic, for wall mounting.
2. Scale(s): Deg F (Deg C) Deg F and deg C.
3. Sensor: Bulb and thermister wire.
   a. Design for Thermowell Installation: Bare stem.
4. Display: Digital.
5. Accuracy: Plus or minus 2 deg F (1 deg C).

## 2.05 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI .
4. Material for Use with Steel Piping: CRES CSA .
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin .

## 2.06 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Liquid-filled Sealed Open-front, pressure relief Solid-front, pressure relief type(s); cast aluminum or drawn steel ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic .
9. Ring: Metal Brass Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Sealed type; plastic ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic .
9. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Liquid-filled Sealed type; cast aluminum or drawn steel metal ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter with back front flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic .
9. Ring: Metal Stainless steel .
10. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type; plastic ; 4-1/2-inch (114-mm) 6-inch (152-mm) nominal diameter with back front flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic .
9. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

**2.07 GAGE ATTACHMENTS**

A. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball Brass or stainless-steel needle, with NPS 1/4 (DN 8) NPS 1/4 or NPS 1/2 (DN 8 or DN 15) NPS 1/2 (DN 15), ASME B1.20.1 pipe threads.

**2.08 TEST PLUGS**

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C) .

E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

**2.09 TEST-PLUG KITS**

A. Furnish one test-plug kit(s) containing one two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C) .

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C) .

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa) <Insert range>.

E. Carrying Case: Metal or plastic, with formed instrument padding.

**2.10 SIGHT FLOW INDICATORS**

A. Description: Piping inline-installation device for visual verification of flow.

B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

C. Minimum Pressure Rating: 125 psig (860 kPa) 150 psig (1034 kPa) .

D. Minimum Temperature Rating: 200 deg F (93 deg C) .

E. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

F. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid one-third of pipe diameter to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:
1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:
1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

### 3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### 3.03 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

### 3.04 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
1. Liquid-filled Sealed, bimetallic-actuated type.
2. Direct Remote-mounted, metal plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Direct Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
1. Liquid-filled Sealed, bimetallic-actuated type.
2. Direct Remote-mounted, metal plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Direct Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:

1. Liquid-filled Sealed, bimetallic-actuated type.
2. Direct Remote-mounted, metal plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Direct Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
1. Liquid-filled Sealed, bimetallic-actuated type.
2. Direct Remote-mounted, metal plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Direct Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

E. Thermometer stems shall be of length to match thermowell insertion length.

**3.05 THERMOMETER SCALE-RANGE SCHEDULE**

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) 0 to 150 deg F and minus 20 to plus 70 deg C.

C. Scale Range for Domestic Cold-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) 30 to 240 deg F and 0 to plus 115 deg C.

D. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C) 0 to 250 deg F and 0 to 150 deg C.

E. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F (0 to 150 deg C) 20 to 240 deg F and 0 to 150 deg C.

F. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) 30 to 240 deg F and 0 to plus 115 deg C.

G. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) 0 to 100 deg F and minus 20 to plus 50 deg C.

H. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) 0 to 150 deg F and minus 20 to plus 70 deg C.

**3.06 PRESSURE-GAGE SCHEDULE**

A. Pressure gages at discharge of each water service into building shall be one of the following:
1. Liquid-filled Sealed Open-front, pressure-relief Solid-front, pressure-relief , direct remote-mounted, metal case.
2. Sealed , direct remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
1. Liquid-filled Sealed Open-front, pressure-relief Solid-front, pressure-relief , direct remote-mounted, metal case.
2. Sealed , direct remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
1. Liquid-filled Sealed Open-front, pressure-relief Solid-front, pressure-relief , direct remote-mounted, metal case.
2. Sealed , direct remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

## 3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi (0 to 600 kPa) 0 to 100 psi and 0 to 600 kPa.

B. Scale Range for Water Service Piping: 0 to 160 psi (0 to 1100 kPa) 0 to 160 psi and 0 to 1100 kPa.

C. Scale Range for Water Service Piping: 0 to 200 psi (0 to 1400 kPa) 0 to 200 psi and 0 to 1400 kPa.

D. Scale Range for Domestic Water Piping: 0 to 100 psi (0 to 600 kPa) 0 to 100 psi and 0 to 600 kPa.

E. Scale Range for Domestic Water Piping: 0 to 160 psi (0 to 1100 kPa) 0 to 160 psi and 0 to 1100 kPa.

F. Scale Range for Domestic Water Piping: 0 to 200 psi (0 to 1400 kPa) 0 to 200 psi and 0 to 1400 kPa.

G. Scale Range for Domestic Water Piping: 0 to 300 psi (0 to 2500 kPa) 0 to 300 psi and 0 to 2500 kPa.

**END OF SECTION**

**SECTION 22 05 23.12**

**BALL VALVES FOR PLUMBING PIPING**

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
   1. Brass ball valves.
   2. Bronze ball valves.
   3. Steel ball valves.
   4. Iron ball valves.

### 1.03 DEFINITIONS

A. CWP: Cold working pressure.

### 1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 and NSF 372.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.
   3. Set ball valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for solder-joint connections.
   6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100) .

H. Valves in Insulated Piping:
1. Include 2-inch (50-mm) stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

**2.02 BRASS BALL VALVES**

A. One-Piece, Brass Ball Valves:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Forged brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass or stainless steel.
h. Ball: Chrome-plated brass or stainless steel.
i. Port: Reduced.

B. Two-Piece, Brass Ball Valves with Full Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Two-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

D. Two-Piece, Brass Ball Valves with Regular Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Forged brass.

e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

E. Two-Piece, Brass Ball Valves with Regular Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

F. Three-Piece, Brass Ball Valves with Full Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

G. Three-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

**2.03 BRONZE BALL VALVES**

A. One-Piece, Bronze Ball Valves with Bronze Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. One-Piece, Bronze Ball Valves with Stainless-Steel Trim:

1. Description:
    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: One piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel, vented.
    i. Port: Reduced.

C. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:
1. Description:
    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded and soldered.
    f. Seats: PTFE.
    g. Stem: Bronze or brass.
    h. Ball: Chrome-plated brass.
    i. Port: Full.

D. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
1. Description:
    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded or soldered.
    f. Seats: PTFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel, vented.
    i. Port: Full.

E. Two-Piece, Bronze Ball Valves with Regular Port and Bronze or Brass Trim:
1. Description:
    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE.
    g. Stem: Bronze or brass.
    h. Ball: Chrome-plated brass.
    i. Port: Regular.

F. Two-Piece, Bronze Ball Valves with Regular Port and Stainless-Steel Trim:
1. Description:
    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig (4140 kPa).
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE.

g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

G. Three-Piece, Bronze Ball Valves with Full Port and Bronze or Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

H. Three-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

I. Three-Piece, Bronze Ball Valves with Regular Port and Bronze Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece
d. Body Material: Bronze
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Regular.

J. Three-Piece, Bronze Ball Valves with Regular Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

K. Two-Piece, Safety-Exhaust, Bronze Ball Valves:
1. Description:
a. Standard: MSS SP-110.

b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Bronze, ASTM B 584, Alloy C844.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
i. Port: Full.

**2.04 STEEL BALL VALVES**

A. Class 150, Steel Ball Valves with Full Port:
1. Description:
a. Standard: MSS SP-72.
b. CWP Rating: 285 psig (1964 kPa).
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

B. Class 150, Steel Ball Valves with Regular Port:
1. Description:
a. Standard: MSS SP-72.
b. CWP Rating: 285 psig (1964 kPa).
c. Body Design: Uni-body.
d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

**2.05 IRON BALL VALVES**

A. Class 125, Iron Ball Valves:
1. Description:
a. Standard: MSS SP-72.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

**PART 3 EXECUTION**

**3.01 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.

**3.02 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.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

**3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
1. For Copper Tubing, NPS 2 (DN 50) 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 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

**3.04 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. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze stainless-steel trim.
4. Two-piece, brass ball valves with full regular port and brass stainless-steel trim.
5. Two-piece, bronze ball valves with full regular port and bronze or brass stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze or brass stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full regular port.
3. Class 150, iron ball valves.

**END OF SECTION**

## SECTION 22 05 23.14
## CHECK VALVES FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
   1. Bronze lift check valves.
   2. Bronze swing check valves.
   3. Iron swing check valves.
   4. Iron swing check valves with closure control.
   5. Iron, grooved-end swing check valves.
   6. Iron, center-guided check valves.
   7. Iron, plate-type check valves.

#### 1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

#### 1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 and NSF 372.

#### 1.05 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 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

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

**2.02 BRONZE LIFT CHECK VALVES**

A. Class 125, Lift Check Valves with Bronze Disc:
1. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:
1. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: NBR, PTFE.

**2.03 BRONZE SWING CHECK VALVES**

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:
1. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
1. Description:
a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Description:
    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded or soldered. See valve schedule articles.
    f. Disc: PTFE.

## 2.04 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Description:
    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged or threaded. See valve schedule articles.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
1. Description:
    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged or threaded. See valve schedule articles.
    f. Trim: Composition.
    g. Seat Ring: Bronze.
    h. Disc Holder: Bronze.
    i. Disc: PTFE.
    j. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:
1. Description:
    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged or threaded. See valve schedule articles.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.

## 2.05 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
1. Description:
    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged or threaded. See valve schedule articles.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.
    h. Closure Control: Factory-installed exterior lever and weight.

## 2.06 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:
   1. Description:
      a. CWP Rating: 300 psig (2070 kPa).
      b. Body Material: ASTM A 536, ductile iron.
      c. Seal: EPDM.
      d. Disc: Spring operated, ductile iron or stainless steel.

## 2.07 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Material: ASTM A 126, gray iron.
      d. Style: Compact wafer, spring loaded.
      e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Material: ASTM A 126, gray iron.
      d. Style: Globe, spring loaded.
      e. Ends: Flanged.
      f. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 300 psig (2070 kPa).
      c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
      d. Style: Compact wafer, spring loaded.
      e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 300 psig (2070 kPa).
      c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
      d. Style: Globe, spring loaded.
      e. Ends: Flanged.
      f. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 400 psig (2760 kPa).
      c. Body Material: ASTM A 126, gray iron.
      d. Style: Compact wafer, spring loaded.
      e. Seat: Bronze.

F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
   1. Description:
      a. Standard: MSS SP-125.
      b. CWP Rating: 400 psig (2760 kPa).
      c. Body Material: ASTM A 126, gray iron.

d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR .

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR .

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.

b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR .

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR .

P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Description:
a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

## PART 3 EXECUTION

### 3.01 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.

### 3.02 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.

E. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.

2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

**3.03 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.

**3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

A. If valve applications are not indicated, use the following:
1. Pump-Discharge Check Valves:
a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:
1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged.
7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

**3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)**

A. Pipe NPS 2 (DN 50) and Smaller:
1. Vertical, Upflow Applications Only: Bronze lift check valves, Class 125, bronze nonmetallic disc with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves, Class 125 Class 150, bronze nonmetallic disc with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron swing check valves, Class 125 Class 250, metal nonmetallic-to-metal seats with threaded or flanged end connections.
2. Iron, grooved-end swing check valves, 300 CWP.
3. Iron, dual-plate check valves, Class 125 Class 150 Class 250 Class 300, metal resilient seat with threaded or flanged end connections.
4. Iron, single-plate check valves, Class 125 Class 250, resilient seat with threaded or flanged end connections.

**3.06 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))**

A. Pipe NPS 2 (DN 50) and Smaller:
1. Vertical, Upflow Applications Only: Bronze lift check valves, Class 125, bronze nonmetallic disc with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves, Class 125 Class 150, bronze nonmetallic disc with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
   1. Iron swing check valves, Class 125 Class 250, metal nonmetallic-to-metal seats with threaded or flanged end connections.
   2. Iron, grooved-end swing check valves, 300 CWP with threaded or flanged end connections.
   3. Iron, dual-plate check valves, Class 125 Class 150 Class 250 Class 300, metal resilient seat with threaded or flanged end connections.
   4. Iron, single-plate check valves, Class 125 Class 250, resilient seat with threaded or flanged end connections.

**3.07 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

A. Pipe NPS 2 (DN 50) and Smaller: Bronze swing check valves, Class 125 Class 150, bronze nonmetallic disc with soldered or threaded end connections.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
   1. Iron swing check valves, Class 125 Class 250, metal nonmetallic-to-metal seats with threaded or flanged end connections.
   2. Iron swing check valves with closure control, Class 125, lever and spring weight with threaded or flanged end connections.
   3. Iron, grooved-end swing check valves, 300 CWP.
   4. Iron, center-guided check valves, Class 125 Class 150 Class 250 Class 300, compact wafer.
   5. Iron, center-guided check valves, Class 125 Class 150 Class 250 Class 300, globe, metal resilient seat with threaded or flanged end connections.
   6. Iron, dual-plate check valves, Class 125 Class 150 Class 250 Class 300, metal resilient seat with threaded or flanged end connections.
   7. Iron, single-plate check valves, Class 125 Class 250, resilient seat with threaded or flanged end connections.

**END OF SECTION**

## SECTION 22 05 29

## HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.

#### 1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 1.05 ACTION 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.

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.

#### 1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

## 1.07 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

# PART 2 PRODUCTS

## 2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel 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 copper-coated steel stainless steel .

## 2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.03 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:
   1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
   2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass polyurethane or 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.

## 2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   2. Standard: MFMA-4.
   3. Channels: Continuous slotted steel channel with inturned lips.
   4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel .
6. Metallic Coating: Electroplated zinc Hot-dipped galvanized Mill galvanized In-line, hot galvanized Mechanically-deposited zinc.
7. Paint Coating: Vinyl Vinyl alkyd Epoxy Polyester Acrylic Amine Alkyd
8. Plastic Coating: PVC Polyurethane Epoxy Polyester Framing systems in paragraph below should be equal to or able to exceed MFMA-4 requirements.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel .
6. Coating: Zinc Paint PVC

## 2.05 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
1. Channels: Continuous slotted fiberglass or other plastic 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 fiberglass stainless steel .

## 2.06 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

## 2.07 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

## 2.08 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic 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: Plastic 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.

**2.09 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.

**2.010 MISCELLANEOUS MATERIALS**

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

**PART 3 EXECUTION**

**3.01 HANGER AND SUPPORT INSTALLATION**

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. 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 Section 077200 "Roof Accessories" for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) 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. 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.

O. 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
      b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

**3.02 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.

**3.03 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 (40 mm)

**3.04 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 (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**3.05 HANGER AND SUPPORT SCHEDULE**

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900) 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 (DN 25 to DN 750), 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 (DN 65 to DN 600), 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 (DN 50 to DN 1050) 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 (DN 50 to DN 600) 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 (DN 50 to DN 750) 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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) 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-joist 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 (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
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**

## SECTION 22 05 53

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

### 1.03 ACTION 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.

### PART 2 PRODUCTS

### 2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch (0.8-mm) stainless steel, 0.025-inch (0.64-mm) aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Letter Color: Black Blue Red White Yellow .
   3. Background Color: Black Blue Red White Yellow .
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
   6. Fasteners: Stainless-steel rivets or self-tapping screws.
   7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black Blue Red White Yellow .
   3. Background Color: Black Blue Red White Yellow .
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black Blue Red White Yellow .

C. Background Color: Black Blue Red White Yellow .

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover 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; also include 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: Size letters according to ASME A13.1 for piping At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.

## 2.04 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) stainless steel, 0.025-inch (0.64-mm) aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

**2.05 WARNING TAGS**

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum Approximately 4 by 7 inches (100 by 178 mm) <Insert size>.
2. Fasteners: Brass grommet and wire Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

**3.02 GENERAL INSTALLATION REQUIREMENTS**

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.

**3.03 EQUIPMENT LABEL INSTALLATION**

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

**3.04 PIPE LABEL INSTALLATION**

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

B. Pipe Label Locations: 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:
   1. Low-Pressure Compressed Air Piping:
      a. Background: Safety blue .
      b. Letter Colors: White .
   2. High-Pressure Compressed Air Piping:
      a. Background: Safety blue .
      b. Letter Colors: White .
   3. Domestic Water Piping
      a. Background: Safety green .
      b. Letter Colors: White .
   4. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Safety black Safety purple Safety white Safety gray .
      b. Letter Color: Black White .

## 3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and 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: 1-1/2 inches (38 mm) 2 inches (50 mm), round square .
      b. Hot Water: 1-1/2 inches (38 mm) 2 inches (50 mm), round square .
      c. Low-Pressure Compressed Air: 1-1/2 inches (38 mm) 2 inches (50 mm), round square .
      d. High-Pressure Compressed Air: 1-1/2 inches (38 mm) 2 inches (50 mm), round square .
   2. Valve-Tag Colors:
      a. Cold Water: Natural Safety green .
      b. Hot Water: Natural Safety green .
      c. Low-Pressure Compressed Air: Natural Safety blue .
      d. High-Pressure Compressed Air: Natural Safety blue .
   3. Letter Colors:
      a. Cold Water: White .
      b. Hot Water: White .
      c. Low-Pressure Compressed Air: White .
      d. High-Pressure Compressed Air: White .

## 3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

## SECTION 22 07 19
## PLUMBING PIPING INSULATION

### PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.
   4. Sanitary waste piping exposed to freezing conditions.
   5. Supplies and drains for handicap-accessible lavatories and sinks.
   6. Roof drains and rainwater leaders.

### 1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   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.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
   2. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
   3. Sheet Jacket Materials: 12 inches (300 mm) square.
   4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

### 1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

### 1.05 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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 (3-m) section of NPS 2 (DN 50) 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 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) 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. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.06 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.

## 1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

## 1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Block Insulation: ASTM C 552, Type I.
   2. Special-Shaped Insulation: ASTM C 552, Type III.
   3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   4. Preformed Pipe Insulation with Factory-Applied ASJ ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
   5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

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.

I. Mineral-Fiber, Preformed Pipe Insulation:
   1. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket with factory-applied ASJ with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Phenolic:
   1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
   2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
   3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
   4. Factory-Applied Jacket: None ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

### 2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

### 2.03 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 Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

## 2.05 LAGGING

A. APPROVED MANUFACTURERS
1. Kinetics Noise Control, Dublin, OH – www.kineticsnoise.com
2. Wilrep Ltd., Mississauga, Ontario – www.wilrep.com
3. Sound Seal, Agawam, MA – www.soundseal.com
4. Great Lakes Textiles, Walton Hills, OH – www.gltproducts.com
5. Bradford Industries, Lowell, MA – www.bradfordind.com

B. DESCRIPTION OF PRODUCTS
1. Pipe lagging material shall be comprised of an insulating decoupling wrap or batting with a mass-loaded vinyl or other non-porous material barrier layer. Barrier layer shall not be directly adhered to or contact the lagged pipe.\
2. Provide multiple layers of pipe lagging material or heavier weight material on pipes specifically identified on the contract drawings, or in order to achieve the minimum specified weight.
3. Barrier products may be provided with integrated decoupling product, else provide duct wrap/pipe insulation as specified herein.
4. Insulating Decoupling Wrap/Batting
   a. Barrier material shall be separated from the pipe with a glass fiber or foam decoupling layer.
   b. Product shall have a minimum thickness of 2 inches (50mm) unless indicated elsewhere.
   c. Product shall have a minimum density of 2 pounds per cubic foot (32 kg/$m^3$) unless indicated elsewhere.
5. Mass-loaded Vinyl Barrier
   a. Product shall be a flexible, mass-loaded vinyl sheet.
   b. Surface density shall be minimum 2 pounds per square foot (9.7 kg/$m^2$) unless indicated elsewhere.
      1) Multiple layers of lighter weight products is acceptable provided the composite weight of the layers is equal to or greater than the minimum specified surface density.
   c. Flammability: SE “0” in/min.
   d. Acceptable Products
      1) KNM-200B (Kinetics)
      2) Barymat 5 (Wilrep)
      3) B-20 Lag (Sound Seal)
      4) Vinaflex VP-200 (Great Lakes Textiles)

5) 20NL Coustifilm (Bradford)

## 2.06 SEALANTS

A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.07 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.

## 2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

## 2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

## 2.010 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. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White Color-code jackets based on system. Color as selected by Architect.
   3. 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.

C. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
   2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
      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- (3.2-mm-) 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.

**2.011 TAPES**

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches (75 mm).
   2. Thickness: 11.5 mils (0.29 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. 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. Width: 3 inches (75 mm).
   2. Thickness: 6.5 mils (0.16 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. 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. Width: 2 inches (50 mm).
   2. Thickness: 6 mils (0.15 mm).
   3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches (50 mm).
   2. Thickness: 3.7 mils (0.093 mm).
   3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

**2.012 SECUREMENTS**

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) 3/4 inch (19 mm) wide with wing seal or closed seal.
   2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) 3/4 inch (19 mm) wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy 0.062-inch (1.6-mm) soft-annealed, stainless steel 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

**2.013 PROTECTIVE SHIELDING GUARDS**

A. Protective Shielding Pipe Covers, :
   1. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, :

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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

### 3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 4 inches (100 mm) o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, 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.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. 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. Cleanouts.

**3.04 PENETRATIONS**

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

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 Section 078413 "Penetration Firestopping" for firestopping 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 Section 078413 "Penetration Firestopping."

**3.05 GENERAL PIPE INSULATION INSTALLATION**

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

**3.06 INSTALLATION OF CELLULAR-GLASS INSULATION**

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 (150 mm) o.c.
   4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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 (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

## 3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

## 3.08 INSTALLATION OF MINERAL-FIBER INSULATION

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.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, 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 (25 mm), 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.

**3.09 INSTALLATION OF PHENOLIC INSULATION**

A. General Installation Requirements:
   1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
   2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. 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 (150 mm) o.c.
   4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. 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 block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
   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.

**3.010 INSTALLATION OF POLYOLEFIN INSULATION**

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet 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.
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.

**3.011 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) overlap at longitudinal seams and end joints. 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 (50-mm) 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 (300 mm) o.c. and at end joints.

**3.012 FINISHES**

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

### 3.013 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.014 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.

### 3.015 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches (38 mm) thick.
      b. Flexible Elastomeric:1 inch (25 mm) thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
      d. Phenolic: 1 inch (25 mm) thick.
      e. Polyolefin: 1 inch (25 mm) thick.
   2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches (38 mm) thick.
      b. Flexible Elastomeric: 1 inch (25 mm) thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
      d. Phenolic: 1 inch (25 mm) thick.
      e. Polyolefin: 1 inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:
   1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches (38 mm) thick.
      b. Flexible Elastomeric: 1 inch (25 mm) thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
      d. Phenolic: 1 inch (25 mm) thick.
      e. Polyolefin: 1 inch (25 mm) thick.
   2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches (38 mm) thick.
      b. Flexible Elastomeric: 1 inch (25 mm) thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
      d. Phenolic: 1 inch (25 mm) thick.
      e. Polyolefin: 1 inch (25 mm) thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
    a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    c. Polyolefin: 1/2 inch (13 mm) 3/4 inch (19 mm) 1 inch (25 mm) thick.

D. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.
    c. Phenolic: 1-1/2 inches (38 mm) thick.

E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. All Pipe Sizes: Insulation shall be one of the following:
    a. Cellular Glass: 1-1/2 inches (38 mm) thick.
    b. Flexible Elastomeric: 1 inch (25 mm) thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    d. Phenolic: 1 inch (25 mm) thick.
    e. Polyolefin: 1 inch (25 mm) thick.

F. Stormwater and Overflow:
1. All Pipe Sizes: Insulate the first 20’-0” from the roof drain throughout the space. Above the gym, the entire horizontal run shall be insulated. Insulation shall be one of the following:
    a. Cellular Glass: 1-1/2 inches (38 mm) thick.
    b. Flexible Elastomeric: 1 inch (25 mm) thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    d. Phenolic: 1 inch (25 mm) thick.
    e. Polyolefin: 1 inch (25 mm) thick.

G. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be one of the following:
    a. Cellular Glass: 1-1/2 inches (38 mm) thick.
    b. Flexible Elastomeric: 1 inch (25 mm) thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    d. Phenolic: 1 inch (25 mm) thick.
    e. Polyolefin: 1 inch (25 mm) thick.

**END OF SECTION**

## SECTION 22 11 16
## DOMESTIC WATER PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
   1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
   2. Encasement for piping.

#### 1.03 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

#### 1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

#### 1.05 FIELD 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. Notify Architect Construction Manager Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Architect's Construction Manager's Owner's written permission.

### PART 2 PRODUCTS

#### 2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

#### 2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:
   1. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:
1. Description:
a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee Connections:
1. Description: Tee formed in copper tube according to ASTM F 2014.

J. Appurtenances for Grooved-End Copper Tubing:
1. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
2. Mechanical Couplings for Grooved-End Copper Tubing:
a. Copper-tube dimensions and design similar to AWWA C606.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 300 psig (2070 kPa).

**2.03 DUCTILE-IRON PIPE AND FITTINGS**

A. Mechanical-Joint, Ductile-Iron Pipe:
1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:
1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:
1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:
1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:
1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:
1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe:
1. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
2. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
a. AWWA C606 for ductile-iron-pipe dimensions.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.

d. Bolts and nuts.
e. Minimum Pressure Rating:
1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig (1725 kPa)
2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig (1035 kPa)

## 2.04 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:
1. ASTM A 53/A 53M, Type E , Grade B , Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:
1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:
1. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
2. Fittings for Grooved-End, Galvanized-Steel Pipe:
a. AWWA C606 for steel-pipe dimensions.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating:
1) NPS 8 (DN 200) and Smaller: 600 psig (4137 kPa) .
2) NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig (2758 kPa) .
3) NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa) .

## 2.05 STAINLESS-STEEL PIPING

A. Potable-water piping and components shall comply with NSF 61.

B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.

C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.

D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
1. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
2. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
a. AWWA C606 for stainless-steel-pipe dimensions.
b. Stainless-steel housing sections.
c. Stainless-steel bolts and nuts.
d. EPDM-rubber gaskets suitable for hot and cold water.
e. Minimum Pressure Rating:
1) NPS 8 (DN 200) and Smaller: 600 psig (4137 kPa) .
2) NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig (2758 kPa) .
3) NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa) .

## 2.06 PEX TUBE AND FITTINGS

A. All PEX piping and fittings must meet flame spread ASTM E85 certification. No exceptions. Plenum return utilized in project, and thus all piping must meet that within plenum space. If piping is not rated, then contractor to carry the cost to insulate all piping with fire wrap insulation

to meet the ASTM E85 requirement by code. This note has been highlighted, added to sheets as well so there is zero confusion for bidding.

B. PEX Distribution System: ASTM F 877, SDR 9 tubing.

C. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

D. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

**2.07 PEX-AL-PEX TUBE AND FITTINGS**

A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.

B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

**2.08 PEX-AL-HDPE TUBE AND FITTINGS**

A. PEX-AL-HPDE Distribution System: ASTM F 1986 tubing.

B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

**2.09 PVC PIPE AND FITTINGS**

A. All PVC piping and fittings must meet flame spread ASTM E85 certification. No exceptions. Plenum return utilized in project, and thus all piping must meet that within plenum space. If piping is not rated, then contractor to carry the cost to insulate all piping with fire wrap insulation to meet the ASTM E85 requirement by code. This note has been highlighted, added to sheets as well so there is zero confusion for bidding.

B. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80

C. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.

D. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

**2.010 PP PIPE AND FITTINGS**

A. PP Pipe: ASTM F 2389, SDR 7.4 and SDR 11.

B. PVC Socket Fittings: ASTM F 2389.

**2.011 PIPING JOINING MATERIALS**

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

**2.012 ENCASEMENT FOR PIPING**

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural

**2.013 TRANSITION FITTINGS**

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings:
   1. Description:
      a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
      b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:
   1. Description:
      a. PVC four-part union.
      b. Brass or stainless-steel threaded end.
      c. Solvent-cement-joint or threaded plastic end.
      d. Rubber O-ring.
      e. Union nut.

**2.014 DIELECTRIC FITTINGS**

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Standard: ASSE 1079.
   2. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 250 psig (1725 kPa) .
   3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Standard: ASSE 1079.
   2. Factory-fabricated, bolted, companion-flange assembly.
   3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 175 psig (1200 kPa) 300 psig (2070 kPa) .
   4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Nonconducting materials for field assembly of companion flanges.
   2. Pressure Rating: 150 psig (1035 kPa) .
   3. Gasket: Neoprene or phenolic.
   4. Bolt Sleeves: Phenolic or polyethylene.
   5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
   1. Standard: IAPMO PS 66.

2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C) .
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

## PART 3 EXECUTION

### 3.01 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. 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 for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

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.

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 to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

**3.03 JOINT CONSTRUCTION**

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

L. 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.

M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
   2. PVC Piping: Join according to ASTM D 2855.

N. Joints for PEX Piping: Join according to ASTM F 1807.

O. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

**3.04 TRANSITION FITTING INSTALLATION**

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

**3.05 DIELECTRIC FITTING INSTALLATION**

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings couplings or nipples nipples unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges flange kits nipples.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

**3.06 HANGER AND SUPPORT INSTALLATION**

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
   5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
   6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

E. Install supports for vertical copper tubing every 10 feet (3 m).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

H. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

I. Install supports for vertical stainless-steel piping every 15 feet (4.5 m).

J. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.

K. Install hangers for vertical PEX piping every 48 inches (1200 mm).

L. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

M. Install supports for vertical PVC piping every 48 inches (1200 mm).

N. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

O. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.

P. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

**3.07 CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code.
   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 (DN 65) and larger.

**3.08 IDENTIFICATION**

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

**3.09 FIELD QUALITY CONTROL**

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. 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:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. 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.
      c. 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.
      d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

**3.010 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 hot-water flow 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.

**3.011 CLEANING**

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

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. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

## 3.012 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
   1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.
   2. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.
   3. PP, SDR 7.4 SDR 11 socket fittings; and fusion-welded joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:
   1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
   2. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
   3. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.
   4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
   5. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.
   6. PP, SDR 7.4 SDR 11 socket fittings; and fusion-welded joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) , shall be one of the following:
   1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
   2. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.
   3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
   1. Hard or soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.
   2. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.
   3. PP, SDR 7.4 SDR 11 socket fittings; and fusion-welded joints.

H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
   1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
   2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) ASTM B 88, Type M (ASTM B 88M, Type C); cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.
   3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); copper pressure-seal-joint fittings; and pressure-sealed joints.
   4. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); copper push-on-joint fittings; and push-on joints.
   5. PEX tube, NPS 1 (DN 25) and smaller; fittings for PEX tube; and crimped joints.

6. PE-AL-PE tube, NPS 1 (DN 25) and smaller; fittings for PE-AL-PE tube; and crimped joints
7. PEX-AL-PEX tube, NPS 1 (DN 25) and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
8. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.
9. PP, SDR 7.4 SDR 11 socket fittings; and fusion-welded joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) ASTM B 88, Type M (ASTM B 88M, Type C); cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); grooved-joint, copper-tube appurtenances; and grooved joints.
4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
6. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.
7. PP, SDR 7.4 SDR 11 socket fittings; and fusion-welded joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) ASTM B 88, Type M (ASTM B 88M, Type C); cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); grooved-joint, copper-tube appurtenances; and grooved joints.
3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
5. Stainless-steel Schedule 10 Schedule 40 pipe, grooved-joint fittings, and grooved joints.
6. PVC, Schedule 40 Schedule 80; socket fittings; and solvent-cemented joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to (DN 300), shall be one of the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
4. Stainless-steel Schedule 10 Schedule 40 pipe, grooved-joint fittings, and grooved joints.

**3.013 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 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) 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**

## SECTION 22 11 19
## DOMESTIC WATER PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Water pressure-reducing valves.
   4. Balancing valves.
   5. Temperature-actuated, water mixing valves.
   6. Water-hammer arresters.
   7. Air vents.
   8. Trap-seal primer valves.
   9. Trap-seal primer systems.

#### 1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

#### 1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

#### 1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

#### 2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

#### 2.03 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :
   1. Standard: ASSE 1001.
   2. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: Threaded.
   5. Finish: Rough bronze Chrome plated.

B. Hose-Connection Vacuum Breakers :
   1. Standard: ASSE 1011.
   2. Body: Bronze, nonremovable, with manual drain.
   3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   4. Finish: Chrome or nickel plated Rough bronze.

C. Pressure Vacuum Breakers :
   1. Standard: ASSE 1020.

2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
4. Size: <Insert NPS (DN)>.
5. Design Flow Rate: <Insert gpm (L/s)>.
6. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
7. Pressure Loss at Design Flow Rate: <Insert psig (kPa)>.
8. Accessories:
    a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers :
1. Standard: ASSE 1035.
2. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10) matching faucet size.
3. Body: Bronze.
4. End Connections: Threaded.
5. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers :
1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 (DN 8) NPS 3/8 (DN 10) NPS 1/2 (DN 15) NPS 3/4 (DN 20) NPS 1 (DN 25).
4. Accessories:
    a. Valves: Ball type, on inlet and outlet.

## 2.04 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers :
1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 (DN 15) NPS 3/4 (DN 20).
4. Body: Bronze.
5. End Connections: Union, solder Solder joint.
6. Finish: Chrome plated Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers :
1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
4. Pressure Loss at Design Flow Rate: for sizes NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved steel with interior lining that complies with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 (DN 65) and larger.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Configuration: Designed for horizontal, straight-through vertical-inlet, horizontal-center-section, and vertical-outlet vertical flow.
8. Accessories:
    a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies :
1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.

4. Selected Unit Flow Range Limits:
5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved steel with interior lining that complies with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 (DN 65) and larger.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
    a. ValvesNPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers :
1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
4. Body: Stainless steel.
5. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers :
1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 (DN 15) NPS 3/4 (DN 20) NPS 1 (DN 25) NPS 1-1/4 (DN 32).
4. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers :
1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
4. Body: Stainless steel.
5. End Connections: Threaded.

G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies :
1. Standard: ASSE 1047 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
4. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved Steel with interior lining that complies with AWWA C550 or that is FDA approved Stainless steel.
5. End Connections: Flanged.
6. Configuration: Designed for horizontal, straight-through vertical-inlet, horizontal-center-section, and vertical-outlet vertical flow.
7. 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.

H. Double-Check, Detector-Assembly Backflow Preventers :
1. Standard: ASSE 1048 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
4. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved Steel with interior lining that complies with AWWA C550 or that is FDA approved Stainless steel.
5. End Connections: Flanged.

6. Configuration: Designed for horizontal, straight-through vertical-inlet, horizontal-center-section, and vertical-outlet vertical flow.
7. 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.

I. Hose-Connection Backflow Preventers :
1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water (30-kPa) back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm (0.19-L/s) flow.

J. Backflow-Preventer Test Kits :
1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.05 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves :
1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves :
1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves :
1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 2 (DN 50) or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

## 2.06 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices :
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa).
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Chrome plated Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves :
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa)minimum unless otherwise indicated.
3. Type: Exposed-mounted Cabinet-type, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.

5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Chrome plated Polished, chrome plated Rough bronze.
8. Piping Finish: Chrome plated Copper.
9. Cabinet: Factory fabricated, stainless steel, for recessed surface mounting and with hinged, stainless-steel door.

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies :
1. Description: Factory-fabricated, cabinet-type exposed-mounted, thermostatically controlled, water mixing-valve assembly in two three-valve parallel arrangement.
2. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
3. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Small-Flow Parallel: Thermostatic, water mixing valve.
5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
7. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
8. Cabinet: Factory fabricated, stainless steel, for recessed surface mounting and with hinged, stainless-steel door.
9. Thermostatic Mixing Valve and Water Regulator Finish: Chrome plated Polished, chrome plated Rough bronze.
10. Piping Finish: Chrome plated Copper.

D. Photographic-Process, Thermostatic, Water Mixing-Valve Assemblies :
1. Standard: ASSE 1017, thermostatically controlled, water mixing valve made for precise, process-water temperature control.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Body: Bronze with corrosion-resistant interior components.
4. Connections: Threaded inlets and outlet.
5. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, thermometer, shutoff valve, and adjustable, temperature-control handle.
6. Cabinet: Factory fabricated, stainless steel, for surface mounting; with controls and thermometer mounted on front.

E. Individual-Fixture, Water Tempering Valves :
1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.

F. Primary Water Tempering Valves :
1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Body: Bronze.
4. Temperature Control: Manual.
5. Inlets and Outlet: Threaded.

## 2.07 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :
1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.

2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm) 0.033 inch (0.84 mm) 0.062 inch (1.57 mm) .
   b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm) 0.062 inch (1.57 mm) 0.125 inch (3.18 mm) .
   c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm) 0.125 inch (3.18 mm) 0.25 inch (6.35 mm) .
6. Drain: Pipe plug Factory-installed, hose-end drain valve.

**2.08 WATER-HAMMER ARRESTERS**

A. Water-Hammer Arresters :
1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

**2.09 AIR VENTS**

A. Bolted-Construction Automatic Air Vents :
1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) NPS 1/2 (DN 15) 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 (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

**2.010 TRAP-SEAL PRIMER DEVICE**

A. Supply-Type, Trap-Seal Primer Device :
1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device :
1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

**2.011 TRAP-SEAL PRIMER SYSTEMS**

A. Trap-Seal Primer Systems :

1. Standard: ASSE 1044.
2. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.
3. Cabinet: Recessed Surface-mounted steel box with stainless-steel cover.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
   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.
5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: Four Six Eight .
7. Size Outlets: NPS 1/2 (DN 15) NPS 5/8 (DN 18).

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. 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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Install ground hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

J. Install draining-type post hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. (0.03 cu. m) of concrete block at grade.

K. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

M. Install water-hammer arresters in water piping according to PDI-WH 201.

N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

O. 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.

P. 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.

Q. 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.

## 3.02 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

## 3.03 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. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water mixing-valve assemblies.
13. Photographic-process, thermostatic, water mixing-valve assemblies.
14. Primary water tempering valves.
15. Outlet boxes.
16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

## 3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
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. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.05 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**

## SECTION 22 13 16
## SANITARY WASTE AND VENT PIPING

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

### 1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa) .
   2. Waste, Force-Main Piping: 50 psig (345 kPa) 100 psig (690 kPa) 150 psig (1035 kPa) .

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 .

### 1.04 ACTION SUBMITTALS

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

B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

### 1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

### 1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

### 1.07 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Architect Construction Manager Owner no fewer than two  days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Architect's Construction Manager's Owner's written permission.

### PART 2 PRODUCTS

### 2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:
   1. Standards: ASTM C 1277 and CISPI 310.
   2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:
   1. Standards: ASTM C 1277 and ASTM C 1540.
   2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:
   1. Standard: ASTM C 1277.
   2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.04 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:
   1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
   2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
   3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
   1. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
   2. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

## 2.05 STAINLESS-STEEL PIPE AND FITTINGS

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

## 2.06 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:
1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:
1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
a. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
b. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

## 2.07 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

E. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.08 PVC PIPE AND FITTINGS

A. All PVC piping and fittings must meet flame spread ASTM E85 certification. No exceptions. Plenum return utilized in project, and thus all piping must meet that within plenum space. If piping is not rated, then contractor to carry the cost to insulate all piping with fire wrap insulation to meet the ASTM E85 requirement by code. This note has been highlighted, added to sheets as well so there is zero confusion for bidding.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.09 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      a. Standard: ASTM C 1173.
      b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      c. Sleeve Materials:
         1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
         2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   4. Shielded, Nonpressure Transition Couplings:
      a. Standard: ASTM C 1460.
      b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   5. Pressure Transition Couplings:
      a. Standard: AWWA C219.
      b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
      c. Center-Sleeve Material: Manufacturer's standard Carbon steel Stainless steel Ductile iron Malleable iron.
      d. Gasket Material: Natural or synthetic rubber.
      e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:
   1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
   2. Dielectric Unions:
      a. Description:
         1) Standard: ASSE 1079.
         2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 250 psig (1725 kPa).
         3) End Connections: Solder-joint copper alloy and threaded ferrous.
   3. Dielectric Flanges:

a. Description:
1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 175 psig (1200 kPa) 300 psig (2070 kPa).
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
a. Description:
1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig (1035 kPa) .
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:
a. Description:
1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C) <Insert pressure and temperature>.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

**2.010 ENCASEMENT FOR UNDERGROUND METAL PIPING**

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural <Insert color>.

## PART 3 EXECUTION

### 3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.02 PIPING INSTALLATION

A. 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.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install aboveground PVC piping according to ASTM D 2665.

R. Install underground PVC piping according to ASTM D 2321.

S. Install engineered soil and waste drainage and vent piping systems as follows:
   1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
   2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

T. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

U. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
   1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

V. Install force mains at elevations indicated.

W. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

X. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Y. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Z. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

AA. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

**3.03 JOINT CONSTRUCTION**

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. 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.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

**3.04 SPECIALTY PIPE FITTING INSTALLATION**

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
   a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
   b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) : Use dielectric flanges flange kits nipples.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

**3.05 VALVE INSTALLATION**

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:
1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

**3.06 HANGER AND SUPPORT INSTALLATION**

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

I. Install supports for vertical steel piping every 15 feet (4.5 m).

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

K. Install supports for vertical stainless-steel piping every 10 feet (3 m).

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

M. Install supports for vertical copper tubing every 10 feet (3 m).

N. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

O. Install supports for vertical PVC piping every 48 inches (1200 mm).

P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

**3.07 CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Install horizontal backwater valves with cleanout cover flush with floor in pit with pit cover flush with floor <Insert description>.
   6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
   7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main.
   2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. 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.

## 3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

## 3.09 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water

to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) 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.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

## 3.010 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

## 3.011 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
6. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints. See material note about meeting ASTM E85 requirements.
7. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.

5. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints. See material note about meeting ASTM E85 requirements.
6. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
   a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.
6. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints. See material note about meeting ASTM E85 requirements.
7. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints. See material note about meeting ASTM E85 requirements.
5. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:
1. Extra Heavy Service class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
4. Solid wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
1. Extra Heavy Service class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; coupled joints.
3. Solid-wall Cellular-core PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be any of the following:
1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) shall be any of the following:
1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller shall be any of the following:
1. Hard Soft copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 (DN 40) and pressure transition coupling for NPS 1-1/2 (DN 40) and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains NPS 5 (DN 125) and larger shall be any of the following:
1. Hard copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Pressure transition couplings if dissimilar pipe materials.

**END OF SECTION**

## SECTION 22 13 19
## SANITARY WASTE PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Channel drainage systems.
6. Air-admittance valves.
7. Roof flashing assemblies.
8. Through-penetration firestop assemblies.
9. Miscellaneous sanitary drainage piping specialties.
10. Flashing materials.

#### 1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

#### 1.04 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
1. Wiring Diagrams: Power, signal, and control wiring.

#### 1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

#### 1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.07 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

# PART 2 PRODUCTS

## 2.01 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves :
   1. Standard: ASME A112.14.1.
   2. Size: Same as connected piping.
   3. Body: Cast iron.
   4. Cover: Cast iron with bolted or threaded access check valve.
   5. End Connections: Hub and spigot Hub and spigot or hubless Hubless.
   6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed open for airflow unless subject to backflow condition.
   7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves :
   1. Size: Same as floor drain outlet.
   2. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
   3. Check Valve: Removable ball float.
   4. Inlet: Threaded.
   5. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves :
   1. Size: Same as connected piping.
   2. Body: ABS PVC.
   3. Cover: Same material as body with threaded access to check valve.
   4. Check Valve: Removable swing check.
   5. End Connections: Socket type.

## 2.02 CLEANOUTS

A. Exposed Metal Cleanouts :
   1. ASME A112.36.2M, Cast-Iron Cleanouts:
   2. ASME A112.3.1, Stainless-Steel Cleanouts:
   3. Standard: ASME A112.36.2M for cast iron ASME A112.3.1 for stainless steel for cleanout test tee.
   4. Size: Same as connected drainage piping
   5. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee Stainless-steel tee with side cleanout as required to match connected piping.
   6. Closure: Countersunk Countersunk or raised-head Raised-head, brass cast-iron plastic plug.
   7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
   8. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts :
   1. ASME A112.36.2M, Cast-Iron Cleanouts:
   2. ASME A112.36.2M, Stainless-Steel Cleanouts:
   3. ASME A112.3.1, Stainless-Steel Cleanouts:
   4. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule heavy-duty, adjustable housing threaded, adjustable housing cleanout.
   5. Size: Same as connected branch.

6. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule Heavy-duty, adjustable housing Threaded, adjustable housing.
7. Body or Ferrule: Cast iron Stainless steel .
8. Clamping Device: Not required Required.
9. Outlet Connection: Inside calk Spigot Threaded.
10. Closure: Brass plug with straight threads and gasket Brass plug with tapered threads Cast-iron plug Plastic plug.
11. Adjustable Housing Material: Cast iron Plastic with threads set-screws or other device.
12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy Painted cast iron Polished bronze Rough bronze Stainless steel <Insert material and finish>.
13. Frame and Cover Shape: Round Square .
14. Top Loading Classification: Extra Heavy Heavy Light Medium Duty.
15. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.
16. Standard: ASME A112.3.1.
17. Size: Same as connected branch.
18. Housing: Stainless steel.
19. Closure: Stainless steel with seal.
20. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts :
1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk Countersunk or raised-head Raised-head, drilled-and-threaded brass cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, deep, chrome-plated bronze flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts :
1. Size: Same as connected branch.
2. Body: PVC.
3. Closure Plug: PVC.
4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

**2.03 FLOOR DRAINS**

A. Cast-Iron Floor Drains :
1. Standard: ASME A112.6.3 with backwater valve.
2. Pattern: Area Floor Funnel floor Sanitary drain.
3. Body Material: Gray iron .
4. Seepage Flange: Not required Required.
5. Anchor Flange: Not required Required.
6. Clamping Device: Not required Required.
7. Outlet: Bottom Side .
8. Backwater Valve: Drain-outlet type Integral, ASME A112.14.1, swing-check type Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel Not required .
10. Sediment Bucket: Not required <Insert description>.
11. Top or Strainer Material: Bronze Gray iron Nickel bronze Stainless steel .
12. Top of Body and Strainer Finish: Nickel bronze Polished bronze Rough bronze Stainless steel .

13. Top Shape: Round Square .
14. Dimensions of Top or Strainer: <Insert dimensions and describe body, sump, and grate.>
15. Top Loading Classification: Extra Heavy-Duty Heavy Duty Light Duty Medium Duty <Delete if not applicable>.
16. Funnel: Not required Required <Insert description and dimensions>.
17. Inlet Fitting: Not required Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
18. Trap Material: Bronze Cast iron Copper Not required .
19. Trap Pattern: Deep-seal P-trap Standard P-trap Not required .
20. Trap Features: Cleanout Trap-seal primer valve drain connection Cleanout and trap-seal primer valve drain connection Not required .

B. Stainless-Steel Floor Drains :
1. ASME A112.3.1, Stainless-Steel Floor Drains:
2. ASME A112.6.3, Stainless-Steel Floor Drains:
3. Standard: ASME A112.3.1 ASME A112.6.3.
4. Outlet: Bottom Side .
5. Top or Strainer Material: Stainless steel .
6. Top Shape: Round Square .
7. Dimensions of Top or Strainer: <Insert dimensions and describe body, sump, and grate.>
8. Seepage Flange: Not required Required.
9. Anchor Flange: Not required Required.
10. Clamping Device: Not required Required.
11. Trap-Primer Connection: Not required Required.
12. Trap Material: Cast iron Stainless steel Not required .
13. Trap Pattern: Deep-seal P-trap Standard P-trap Not required .

C. Plastic Floor Drains :
1. Standard: ASME A112.6.3.
2. Material: ABS or PVC .
3. Seepage Flange: Not required Required.
4. Clamping Device: Not required Required.
5. Outlet: Bottom Side .
6. Sediment Bucket: Not required <Insert description>.
7. Top or Strainer Material: Bronze Plastic Stainless steel <Insert other>.
8. Top of Body and Strainer Finish: Nickel bronze Polished bronze Rough bronze Stainless steel <Insert other>.
9. Top Shape: Round Square .
10. Trap Material: Cast iron Plastic drainage piping Not required .
11. Trap Pattern: Standard P-trap Not required .

## 2.04 TRENCH DRAINS

A. Trench Drains :
1. Standard: ASME A112.6.3 for trench drains.
2. Material: Ductile or gray iron.
3. Flange: Anchor Seepage Not required.
4. Clamping Device: Not required Required.
5. Outlet: Bottom End Side .
6. Grate Material: Ductile iron Ductile iron or gray iron Gray iron Stainless steel .
7. Grate Finish: Painted Not required .
8. Dimensions of Frame and Grate: <Insert dimensions and describe body, sump, and grate if required.>
9. Top Loading Classification: Extra Heavy-Duty Heavy Duty Light Duty Medium Duty <Delete if not applicable>.
10. Trap Material: Cast iron Stainless steel Not required .

11. Trap Pattern: Standard P-trap Not required .

**2.05 CHANNEL DRAINAGE SYSTEMS**

A. Stainless-Steel Channel Drainage Systems :
   1. ASME A112.3.1, Stainless-Steel Channel Drainage Systems:
   2. Non-ASME A112.3.1, Stainless-Steel Channel Drainage Systems:
   3. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Standard: ASME A112.3.1, for trench drains.
      b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
         1) Dimensions: 5.8 inches (147 mm) 11.7 inches (297mm) wide. Include number of units required to form total lengths indicated.
      c. Grates: Manufacturer's designation "heavy medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
         1) Material: Ductile iron Fiberglass Galvanized steel Gray iron Stainless steel .
         2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.
      d. Covers: Solid ductile or gray iron stainless steel , of width and thickness that fit recesses in channels, and of lengths indicated.
      e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
      f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
   4. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Channel Sections: Interlocking-joint, stainless steel with level invert.
         1) Dimensions: 6 inches (152 mm) 12 inches (305 mm) wide. Include number of units required to form total lengths indicated.
      b. Grates: Manufacturer's designation "heavy medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
         1) Material: Ductile iron Fiberglass Galvanized steel Gray iron Stainless steel .
         2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.
      c. Covers: Solid ductile or gray iron stainless steel , of width and thickness that fit recesses in channels, and of lengths indicated.
      d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
      e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Polymer-Concrete Channel Drainage Systems :
   1. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:
   2. Narrow, Level-Invert, Polymer-Concrete Channel Drainage Systems:
   3. Wide, Level-Invert, Polymer-Concrete Channel Drainage Systems:
   4. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
         1) Dimensions: 4-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
         2) Frame: Gray-iron or galvanized steel for grates Not required.
      b. Grates: Manufacturer's designation "heavy medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

1) Material: Ductile iron Fiberglass Galvanized steel Gray iron Stainless steel .
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.

c. Covers: Solid ductile or gray iron , of width and thickness that fit recesses in channel sections, and of lengths indicated.

d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with NPS 4 (DN 100) outlets in number and locations indicated.
1) Dimensions: 5-inch (127-mm) inside width and 9-3/4 inches (248 mm) deep. Include number of units required to form total lengths indicated.
2) Frame: Gray-iron or galvanized steel for grates Not required.

g. Grates: Manufacturer's designation "heavy medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
1) Material: Ductile iron Fiberglass Galvanized steel Gray iron Stainless steel .
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.

h. Covers: Solid ductile or gray iron , of width and thickness that fit recesses in channel sections, and of lengths indicated.

i. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

j. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

k. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
1) Dimensions: 8-inch (203-mm) inside width and 13-3/4 inches (350 mm) deep. Include number of units required to form total lengths indicated.
2) Frame: Gray-iron or galvanized steel for grates Not required.

l. Grates: Manufacturer's designation "heavy medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
1) Material: Ductile iron Fiberglass Galvanized steel Gray iron Stainless steel .
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.

m. Covers: Solid ductile or gray iron , of width and thickness that fit recesses in channel sections, and of lengths indicated.

n. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

o. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

C. Polymer-Concrete Sediment Interceptor :
1. Description: 27-inch- (686-mm-) square, precast, polymer-concrete body, with outlets in number and sizes indicated. Include 24-inch- (610-mm-) square, gray-iron slotted grate.
2. Frame: Gray-iron or galvanized steel for grate Not required.

D. FRP Channel Drainage Systems :
1. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
a. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.

1) Dimensions: 4 inches (102 mm) 4 or 6 inches (102 or 152 mm) 6 inches (152 mm) 6 or 8 inches (152 or 203 mm) 8 inches (203 mm) wide. Include number of units required to form total lengths indicated.
2) Frame: Galvanized steel Stainless steel Manufacturer's standard metal for grates.

b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
1) Material: Fiberglass Galvanized steel Gray iron Stainless steel .
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections Not required.

c. Covers: Solid ductile or gray iron , of width and thickness that fit recesses in channel sections, and of lengths indicated.

d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

E. Plastic Channel Drainage Systems :
1. HDPE or PE Channel Drainage Systems:
2. PP Channel Drainage Systems:
3. PVC Channel Drainage Systems:
4. HDPE, PE, PP, or PVC Channel Drainage Systems:
5. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
a. Channel Sections: Interlocking-joint, HDPE or PE PP or PVC modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated.
1) Dimensions: 4 inches (102 mm) wide. Include number of units required to form total lengths indicated.

b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
1) Material: Fiberglass Galvanized steel Gray iron Stainless steel .

c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

## 2.06 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves :
1. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.
4. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves :
1. Standard: ASSE 1050 for vent stacks.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.
4. Size: Same as connected stack vent or vent stack.

C. Wall Box :
1. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
2. Size: About 9 inches wide by 8 inches high by 4 inches deep (230 mm wide by 200 mm high by 100 mm deep).

## 2.07 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :
   1. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) 8 inches (200 mm) 10 inches (250 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
      a. Open-Top Vent Cap: Without cap.
      b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
      c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.08 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies :
   1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   2. Size: Same as connected soil, waste, or vent stack.
   3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
   5. Special Coating: Corrosion resistant on interior of fittings.

## 2.09 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains :
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps :
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
      b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings :
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. Air-Gap Fittings :
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device :
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch (25 mm) 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings :

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps :
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Frost-Resistant Vent Terminals :
1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. Expansion Joints :
1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

**2.010 FLASHING MATERIALS**

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.

4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
      b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
      c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

H. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Install fixture air-admittance valves on fixture drain piping.

L. Install stack air-admittance valves at top of stack vent and vent stack piping.

M. Install air-admittance-valve wall boxes recessed in wall.

N. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

O. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

P. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

Q. Assemble open drain fittings and install with top of hub 1 inch (25 mm) 2 inches (51 mm) above floor.

R. Install deep-seal traps on floor drains and other waste outlets, if indicated.

S. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

T. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

U. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

V. Install vent caps on each vent pipe passing through roof.

W. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

X. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Y. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

Z. Install wood-blocking reinforcement for wall-mounting-type specialties.

AA. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

**3.02 CONNECTIONS**

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

**3.03 FLASHING INSTALLATION**

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

**3.04 LABELING AND IDENTIFYING**

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.05 FIELD QUALITY CONTROL**

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**3.06 PROTECTION**

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

## SECTION 22 42 13.13
## COMMERCIAL WATER CLOSETS

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:
   1. Water closets.
   2. Flushometer valves.
   3. Toilet seats.

#### 1.03 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 water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

#### 1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushometer-Valve Repair Kits: Equal to 10 percent of the amount of each type installed, but no fewer than one six of each type.

### PART 2 PRODUCTS

#### 2.01 WATER CLOSETS

A. Water Closets, Wall Mounted, Back outlet, Top spud, vitreous china
   1. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Bowl Type: Siphon jet.
      c. Style: Flushometer valve
      d. Height: Standard
      e. Rim Contour: Elongated.
      f. Water Consumption: 1.28 GPF Max.
      g. Color: White.
   2. Toilet Seat: see section 2.02 TOILET SEATS
   3. Supply Fittings:
      a. Standard: ASME A112.18.1/CSA B125.1.
      b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
      c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
         1) Operation: Loose key Wheel handle.
      d. Riser:
         1) Size: NPS 1-1/2 (DN 10) NPS 1/2 (DN 15).
         2) Material: Chrome-plated, soft-copper flexible tube ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.

## 2.02 TOILET SEATS

A. Toilet Seats :
   1. Standard: IAPMO/ANSI Z124.5.
   2. Material: Plastic.
   3. Type: Residential Commercial (Standard).
   4. Shape: Regular rim (Open front) Regular rim (Closed front) Elongated rim (Open front) Elongated rim (Closed front).
   5. Configuration: Closed Open front with without cover.
   6. Size: Elongated Regular.
   7. Hinge Type: Check Self-sustaining Self-sustaining, check Self-raising.
   8. Hinge Material: Noncorroding metal Plastic.
   9. Seat Cover: Required Not required.
   10. Color: White.

## 2.03 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves
   1. Standard: ASSE 1037
   2. Minimum Pressure Rating: 125 psig
   3. Features: Include integral check stop and backflow-prevention device.
   4. Material: Brass body with corrosion-resistant components.
   5. Exposed Flushometer-Valve Finish: Chrome plated
   6. Style: Exposed.
   7. Consumption: 1.28 gal (4.8L).
   8. Minimum Inlet: NPS 1 (DN 25).
   9. Minimum Outlet: NPS 1-1/4 (DN 32).

## 2.04 SUPPORTS

A. Water Closet Carrier:
   1. Standard: ASME A112.6.1M.
   2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

## 3.02 INSTALLATION

A. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
   2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
   3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
   1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
   2. Use carrier supports with waste-fitting assembly and seal.
   3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
   4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:
   1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
   4. Install actuators in locations that are easy for people with disabilities to reach.
   5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
   1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to water-closet color.
   3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

**3.03 CONNECTIONS**

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

**3.04 ADJUSTING**

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

**3.05 CLEANING AND PROTECTION**

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

## SECTION 22 42 16.13
## COMMERCIAL LAVATORIES

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:
   1. Lavatories.
   2. Faucets.

### 1.03 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 lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

### 1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

### 1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Servicing and adjustments of automatic faucets.

### 1.06 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. Faucet Washers and O-Rings: Equal to 10 number percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 number percent of amount of each type and size installed.

### PART 2 PRODUCTS

### 2.01 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory : Vitreous china, wall mounted, with back.
   1. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging.
      c. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm), 22 by 14 inches (559 by 356 mm), 23 by 15 inches (584 by 381 mm) .
      d. Faucet-Hole Punching: One hole, Three holes, 2-inch (51-mm) centers, Three holes, 4-inch (102-mm) centers.
      e. Faucet-Hole Location: Top.
      f. Color: White .
      g. Mounting Material: Chair carrier.
   2. Faucet: lavatory faucet designation from "Solid-Brass, Manually Operated Faucets" or "Solid-Brass, Automatically Operated Lavatory Faucets" Article.

3. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier, Type II, concealed-arm lavatory carrier, Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.

B. Lavatory : Ledge back, vitreous china, wall mounted.
   1. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging.
      c. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm), 22 by 14 inches (559 by 356 mm), 23 by 15 inches (584 by 381 mm) .
      d. Faucet-Hole Punching: One hole, Three holes, 2-inch (51-mm) centers, Three holes, 4-inch (102-mm) centers.
      e. Faucet-Hole Location: Top.
      f. Color: White .
      g. Mounting Material: Chair carrier.
   2. Faucet: lavatory faucet designation from "Solid-Brass, Manually Operated Faucets" or "Solid-Brass, Automatically Operated Lavatory Faucets" Article.
   3. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier, Type II, concealed-arm lavatory carrier, Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.

C. Lavatory : Slab type, vitreous china, wall mounted.
   1. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging.
      c. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm), 22 by 14 inches (559 by 356 mm), 23 by 15 inches (584 by 381 mm) .
      d. Faucet-Hole Punching: One hole, Three holes, 2-inch (51-mm) centers, Three holes, 4-inch (102-mm) centers.
      e. Faucet-Hole Location: Top.
      f. Color: White .
      g. Mounting Material: Chair carrier.
   2. Faucet: lavatory faucet designation from "Solid-Brass, Manually Operated Faucets" or "Solid-Brass, Automatically Operated Lavatory Faucets" Article.
   3. Support: ASME A112.6.1M, Type I, exposed-arm lavatory carrier, Type II, concealed-arm lavatory carrier, Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.

**2.02 SOLID-BRASS, MANUALLY OPERATED FAUCETS**

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing, single-control nonmixing, two-handle mixing, commercial, general-duty, solid-brass valve.
   1. Standard: ASME A112.18.1/CSA B125.1.
   2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
   3. Body Type: Centerset, Widespread, Single hole .
   4. Body Material: Commercial, solid brass.
   5. Finish: Polished chrome plate finish.
   6. Maximum Flow Rate: 0.5 gpm (1.5 L/min.) value.
   7. Maximum Flow: 0.25 gal. (0.95 L) value per metering cycle.
   8. Mounting Type: Deck, exposed, Deck, concealed, Back/wall, exposed, Back/wall, concealed.
   9. Valve Handle(s): Single lever, Knob, Knob, nonmetallic, Cross, three arm, Cross, four arm, Wrist blade, 4 inches (102 mm), Elbow, 6 inches (152 mm), Push button .
   10. Spout: Rigid, Swing, Rigid, gooseneck, Swivel, gooseneck type.

11. Spout Outlet: Aerator, Laminar flow, Spray .
12. Operation: Compression, manual, Noncompression, manual.
13. Drain: Not part of faucet .

**2.03 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS**

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

**2.04 SUPPLY FITTINGS**

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key, Wheel handle .

F. Risers:
1. NPS 3/8 (DN 10), NPS 1/2 (DN 15).
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, Chrome-plated, soft-copper flexible tube, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

**2.05 WASTE FITTINGS**

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

C. Trap:
1. Size: NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32), NPS 1-1/4 (DN 32).
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall, one-piece, cast-brass trap with swivel 0.029-inch- (73-mm-) thick tubular brass wall bend trap type; and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

**3.02 INSTALLATION**

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

**3.03 CONNECTIONS**

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

**3.04 ADJUSTING**

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

**3.05 CLEANING AND PROTECTION**

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

## SECTION 22 42 16.16
## COMMERCIAL SINKS

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Kitchen sinks.
2. Handwash sinks.
3. Sink faucets.
4. Supply fittings.
5. Waste fittings.

### 1.03 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 sinks.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

### 1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

### 1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

### 1.06 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. Faucet Washers and O-Rings: Equal to 10 <Insert number> percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 <Insert number> percent of amount of each type and size installed.

### PART 2 PRODUCTS

### 2.01 KITCHEN SINKS

A. Kitchen Sinks : Stainless steel, top mount.
   1. Fixture:
      a. Standards: ASME A112.19.3/CSA B45.4.
      b. Type: Stainless steel, sel-rimming, with radius corners, back for faucet, and support brackets.
      c. Number of Compartments: One
      d. Nominal Size: 25 by 22 by 6 inches (635 by 559 by 152 mm).
   2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
   3. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
   4. Mounting: On counter with sealant

B. Kitchen Sinks : Stainless steel, top mount, two bowl.
   1. Fixture:
      a. Standards: ASME A112.19.3/CSA B45.4.

b. Type: Stainless steel, sel-rimming, with radius corners, back for faucet, and support brackets.
c. Number of Compartments: Two
d. Nominal Size: 25 by 22 by 6 inches (635 by 559 by 152 mm).
2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
3. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
4. Mounting: On counter with sealant.

**2.02 HANDWASH SINKS**

A. Handwash Sinks : Stainless steel, wall mounted.
1. Fixture:
a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
b. Type: Stainless steel, sel-rimming, with radius corners, back for faucet, and support brackets.
c. Number of Compartments: One
d. Nominal Size: 25 by 22 by 6 inches (635 by 559 by 152 mm).
2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
3. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
4. Support: ASME A112.6.1M, Type II, sink carrier.

**2.03 SINK FAUCETS**

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets : Manual type, single-control, two-lever-handle mixing valve.
1. Standard: ASME A112.18.1/CSA B125.1.
2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
3. Body Type: Centerset, Widespread, Single hole .
4. Body Material: Commercial, solid brass, General-duty, solid brass, Copper or brass underbody.
5. Finish: Chrome plated, Polished chrome plate.
6. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
7. Handle(s): Lever, Cross, four arm, Wrist blade, 4 inches (102 mm), Elbow, 6 inches (152 mm), Not applicable <.
8. Mounting Type: Deck, concealed, Deck, exposed, Back/wall, exposed.
9. Spout Type: Rigid, solid brass, Rigid, solid brass with wall brace, Swing, round tubular, Swing, shaped tube, Swing, solid brass, Rigid gooseneck, Swivel gooseneck .
10. Vacuum Breaker: Required, Not required for hose outlet.
11. Spout Outlet: Aerator, Laminar flow, Hose thread according to ASME B1.20.7, Plain end, Spray .

**2.04 SUPPLY FITTINGS**

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key, Wheel handle .

F. Risers:
1. NPS 3/8 (DN 10), NPS 1/2 (DN 15)
2. Chrome-plated, rigid-copper pipe, Chrome-plated, soft-copper flexible tube, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

### 2.05 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.

C. Trap:
   1. Size: NPS 1-1/2 (DN 40).
   2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall, one-piece, cast-brass trap with swivel 0.029-inch- (73-mm-) thick tubular brass wall bend ; and chrome-plated brass or steel wall flange.
   3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

### 2.06 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 (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

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

### 3.02 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.
   1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
   2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.03 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

**3.04 ADJUSTING**

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

**3.05 CLEANING AND PROTECTION**

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

**SECTION 23 00 00**

**BASIC MECHANICAL MATERIALS AND METHODS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Division 1 – General Acoustic Considerations – Definitions including:
   1. Acoustically Isolated Construction (AIC)
   2. Acoustically Sensitive Room (ASR)
   3. Noise Producing Room (NPR)

B. Division 9 – Joint Sealants

C. Division 23 – Vibration and Seismic Controls for Mechanical Systems

### 1.2 SUMMARY

A. Provide acoustical wall, floor, and ceiling penetrations as specified herein and as shown on the Contract Drawings. Verify all dimensions and requirements and coordinate with other trades as necessary to complete the work on schedule.

### 1.3 SUBMITTALS

A. Provide complete submittal including the following:
   1. Manufacturer cut sheets for all products.
      a. Provide for approval a list of alternative products proposed for use to achieve the requirements for airtight seal and no rigid connection between the pipe and the penetrated construction.

B. Shop Drawings: Provide shop drawings for all Penetration Sleeve Assemblies not made by a pre-approved manufacturer listed herein showing the use of alternative products to achieve an airtight closure and no rigid connection between the pipe and the penetrated construction. Additionally, include a narrative for approval which describes specific construction sequencing associated with Alternative Penetration Sleeve Assemblies that will be implemented for:
   1. Conditions when the penetrating pipe is installed prior to the future wall, floor, or ceiling construction.
   2. Conditions when the penetrating pipe is installed following construction of wall, floor, or ceiling elements.

C. Samples: Provide sample of sleeve construction, complete with sample pipe, to Architect, Mechanical Engineer, and Acoustic Consultant if product is not made by a pre-approved manufacturer listed herein.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

A. Mason Industries (Mason), Hauppauge, NY – www.mason-ind.com

B. Kinetics Noise Control (Kinetics), Dublin, OH – www.kineticsnoise.com

C. Amber-Booth Company (ABC), Houston, TX – www.amberbooth.com

D. Vibration Mountings & Controls, Inc. (VMC), Bloomingdale, NJ – www.thevmcgroup.com

E. Armacell LLC (Armacell), Mebane, NC – www.armacell.com

F. Owens Corning (OC), Toledo, OH – www.owenscorning.com

G. Anvil International (Anvil), Exeter, NH – www.anvilintl.com

H. Johns Manville (JM), Denver, CO – www.specjm.com

## 2.2 DESCRIPTION OF PRODUCTS

A. Resilient Penetration Sleeves for Pipes and Conduit

1. Where specified, resilient pipe and conduit penetrations shall be sleeved to avoid rigid connection between the building structure and the penetrating element.
2. Sleeve assembly shall consist of 1/2 inch (13mm) to 3/4 inch (19mm) formed closed cell neoprene foam or semi-rigid glass fiber liner with a metal surround. Inner diameter of sleeve assembly shall match the outer diameter of the associated pipe/conduit. Sleeve assembly may be split to allow it to be clamped once the pipe/conduit is installed.
3. Acceptable products:
   a. SWS Split Acoustical Wall Seal (Mason)
   b. NSW Sleeve (ABC)
   c. VCS Sleeve (VMC)
   d. Approved alternative products which follow the execution requirements identified within this specification section.

B. Alternative Penetration Sleeve Assembly

1. Where specified, resilient pipe and conduit penetrations shall be sleeved to avoid rigid connection between the building structure and the penetrating element.
2. Alternative Penetration Sleeve Assembly shall consist of a formed closed cell neoprene foam or semi-rigid glass fiber liner with a steel surround. Inner diameter of sleeve assembly shall match the outer diameter of the associated pipe/conduit. Sleeve assembly may be split to allow it to be clamped once the pipe is installed.
   a. Liner shall be a minimum 1/2 inch (13mm) thick with density of 6 to 10 pounds per cubic foot (96 to 160 kg/$m^3$)
   b. Surround shall be minimum 22 gauge steel. Surround may be split to allow it to be clamped once the pipe/conduit is installed.
3. Acceptable products (Metal Surround):
   a. Roundup Pipe Insulation Saddles (Buckaroos )
   b. Pipe Saddles (Anvil)
4. Acceptable products (Liner):
   a. Armaflex (Armacell)
   b. Micro-Lok (JM)
   c. Approved Equivalent

C. Perimeter Isolation Board

1. Where specified, ducts and group penetrations shall be sleeved using a 7 to 10 pound per cubic foot (112 to 160 kg/$m^3$) semi-rigid fiber or foam board.
2. Acceptable products:
   a. P7 (Mason)
   b. PIB (Kinetics)
   c. FIBERGLAS Type 707 (Owens Corning)
   d. Approved equivalent

## PART 3 - EXECUTION

### 3.1 GENERAL

A. The Contractor shall notify the Architect and the Acoustics Consultant prior to the installation of millwork, walls, ceilings, or other requirements which would obscure visual inspection of these acoustical products and will provide these parties with an opportunity to review the condition of the mounts prior to any such construction.

### 3.2 INSTALLATION

A. Duct, Conduit, and Piping Installation, General

1. All duct, conduit, and piping that cross the Extent of AIC shall be supported on vibration isolators for a distance of 8 feet (2.5m) measured linearly along the penetrating element.
2. Vibration isolate duct, conduit, and piping that is connected to vibration isolated equipment, as per Division 23 “Vibration and Seismic Control for Mechanical Systems.”
3. Coordinate locations of pipe and conduit penetrations that require sleeves prior to installing pipe/conduit to ensure sleeves are installed with the pipe/conduit. Installer shall be liable for any additional cost due to revision work or product changes due to sleeves not being initially provided.

B. Duct, Conduit, and Pipe Penetrations at Acoustic Applications:

1. Penetration Type A: Resilient and Airtight Penetration.
   a. Type A Penetrations are required for all:
      i. Acoustically Sensitive Rooms with a background noise level of RC-30 or less.
      ii. Penetrations through walls or slabs crossing and within 8 feet (2.5m) crossing of Acoustically Isolated Construction.
      iii. Penetrations through walls, floors, or ceilings of Noise Producing Rooms.
      iv. Wall, floor, or ceiling penetrations within 30 feet (9m) of a connection to vibration isolated equipment.
   b. Type A Penetrations shall be installed as follows, providing an airtight and resilient penetration:
      i. Wall, floor, or ceiling openings for Type A penetrations shall be oversized and sleeved to provide an inner diameter 1 to 2 inches (25 to 50mm) greater than the outside dimension of the sleeve or penetrating element.
      ii. The penetrating element shall be centered in the opening and shall not contact the wall, floor, or ceiling, even after filling.
      iii. The resulting gap shall be packed with glass fiber packing material and foam backer rod on both sides of the wall, floor, or ceiling.
      iv. The gap shall be caulked to an airtight seal using permanently flexible acoustical sealant on both sides of the wall, floor, or ceiling.
   c. For duct penetrations, provide framed opening with perimeter isolation board surround in lieu of sleeves. Stuff gap between the duct and perimeter isolation board with batt insulation. See contract drawings.
2. Penetration Type B: Fire Rated Resilient and Airtight Penetration.

a. Where the use of Firestop is required in the conditions noted above, the packing materials and sealant indicated for Type A penetrations may be replaced with an approved permanently flexible Firestop sealant, creating a resilient and airtight penetration that is also compliant with fire code.

b. In locations not common to Acoustically Sensitive Rooms requiring airtight and resilient penetrations of multiple pipes passing through a wall, floor, or ceiling, it is acceptable to utilize the penetration Type B detail for multiple pipes, as shown on the Contract Drawings.

3. Penetration Type C: Airtight Penetration

a. Duct, Pipe, and, Conduit penetrations of walls, floors, and ceilings of Acoustically Sensitive Rooms which do not meet the conditions for Type A or B pipe penetrations shall utilize Type C Penetrations. Requirements for CMU, Concrete, Gypsum Board, or other walls are typical for both sides of the wall.

b. CMU or Concrete walls, floors, and ceilings: Penetrations shall be grouted and caulked into the structure as follows, forming an airtight penetration:

i. Oversize penetration to provide an inner diameter 1 to 2 inches (25 to 50mm) greater than the outside dimension of the penetrating element.

ii. Before grout has set, rake a groove around the penetrating element on each side of the wall or slab.

iii. The groove shall be 1/2 inch (13mm) wide and 1/2 inch (13mm) deep.

iv. After grout has set, fill the groove full depth with permanently flexible acoustical sealant.

c. Gypsum and wood walls, floors, and ceilings: Penetrations shall be mudded or caulked as follows, forming an airtight penetration:

i. Mud all gaps between gypsum wallboard and penetrating element using joint compound.

ii. After joint compound has set, caulk all gaps to an airtight seal using approved permanently flexible acoustical sealant.

## 3.3 PROTECTION

A. Products that would be exposed to the weather shall be wrapped in temporary protective plastic or other weather-tight coating until building is weather tight.

**END OF SECTION**

## SECTION 23 05 13

## COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

### PART 2 PRODUCTS

#### 2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

#### 2.03 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.

**2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

**2.05 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**

## SECTION 23 05 17

## SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

### 1.03 ACTION SUBMITTALS

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

### PART 2 PRODUCTS

### 2.01 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.

### 2.02 STACK-SLEEVE FITTINGS

A. 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.

### 2.03 SLEEVE-SEAL SYSTEMS

A. 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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

**2.04 SLEEVE-SEAL FITTINGS**

A. 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.

**2.05 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**

**3.01 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 Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with approved firestop materials.

**3.02 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 Section 076200 "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 approved firestop materials.

**3.03 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.

**3.04 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.

**END OF SECTION**

## SECTION 23 05 18

## ESCUTCHEONS FOR HVAC PIPING

### PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.03 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

### 2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated, and, rough-brass 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, and, rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed, and, exposed-rivet hinge, and spring-clip fasteners.

### 2.02 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

### 3.01 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 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 or split-casting brass type with polished, chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge, or split-plate, stamped-steel type with exposed-rivet hinge.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge, or split-plate, stamped-steel type with exposed-rivet hinge.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge, or split-plate, stamped-steel type with exposed-rivet hinge.

h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated, rough-brass finish.

i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge, or split-plate, stamped-steel type with exposed-rivet hinge.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated, rough-brass finish.

k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge, or split-plate, stamped-steel type with exposed-rivet hinge.

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, or, exposed-rivet 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, or, exposed-rivet 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, or, exposed-rivet hinge.

g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated, rough-brass finish.

h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed, or, exposed-rivet hinge.

i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated, rough-brass finish.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed, or, exposed-rivet 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.

**3.02 FIELD QUALITY CONTROL**

A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

**SECTION 23 05 19**

**METERS AND GAGES FOR HVAC 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. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.
11. Orifice flowmeters.
12. Pitot-tube flowmeters.
13. Turbine flowmeters.
14. Venturi flowmeters.
15. Vortex-shedding flowmeters.
16. Impeller-turbine, thermal-energy meters.
17. Ultrasonic, thermal-energy meters.

B. Related Sections:

1. Section 231123 "Facility Natural- Piping" for meters.

## 1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

## 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

## 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

# PART 2 - PRODUCTS

## 2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.

13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

C. Standard: ASME B40.200.

D. Case: Liquid-filled, and, sealed type(s); stainless steel with 3-inch (76-mm), 5-inch (127-mm) nominal diameter.

E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C), deg F and deg C.

F. Connector Type(s): Union joint, adjustable angle, rigid, back, and, rigid, bottom , with unified-inch screw threads.

G. Connector Size: 1/2 inch (13 mm) , with ASME B1.1 screw threads.

H. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

I. Window: Plain glass, or, plastic .

J. Ring: Stainless steel.

K. Element: Bimetal c.

L. Pointer: Dark-colored metal.

M. Accuracy: Plus or minus 1, 1.5 percent of scale range.

## 2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Trerice, H. O. Co.

3. Standard: ASME B40.200.
4. Case: Cast aluminum ; 6-inch (152-mm) nominal size.
5. Case Form: Back angle, Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C), deg F and deg C.
8. Window: Glass or plastic.
9. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

10. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Tel-Tru Manufacturing Company.
    d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    e. Weiss Instruments, Inc.
    f. WIKA Instrument Corporation - USA.
    g. .

3. Standard: ASME B40.200.
4. Case: Plastic ; 6-inch (152-mm) nominal size.
5. Case Form: Back angle, Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F and deg C.
8. Window: Glass or plastic.

9. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

10. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.
    g. Winters Instruments - U.S.
    h. .

3. Standard: ASME B40.200.
4. Case: Cast aluminum ; 7-inch (178-mm), 9-inch (229-mm) nominal size unless otherwise indicated.
5. Case Form: Adjustable angle, Back angle, Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C), deg F and deg C.
8. Window: Glass, or, plastic .
9. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

10. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.

11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ernst Flow Industries.
    b. Marsh Bellofram.
    c. Miljoco Corporation.
    d. Palmer Wahl Instrumentation Group.
    e. REOTEMP Instrument Corporation.
    f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    g. Weiss Instruments, Inc.
    h. WIKA Instrument Corporation - USA.
    i. .

3. Standard: ASME B40.200.
4. Case: Plastic ; 7-inch (178-mm), 9-inch (229-mm) nominal size unless otherwise indicated.
5. Case Form: Adjustable angle, Back angle, Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C), deg F and deg C.
8. Window: Glass, or, plastic .
9. Stem: Aluminum, Brass, Stainless steel, Aluminum, brass, or stainless steel and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

10. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR, or, CUNI .
4. Material for Use with Steel Piping: CRES, CSA .
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin .

## 2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.

i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.
k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

3. Standard: ASME B40.100.
4. Case: Liquid-filled, Sealed, Open-front, pressure relief, Solid-front, pressure relief type(s); cast aluminum or drawn steel ; 4-1/2-inch (114-mm), 6-inch (152-mm) nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa), psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass, or, plastic .
11. Ring: Metal, Brass, Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of, Grade B, plus or minus 2 percent of middle half of, Grade C, plus or minus 3 percent of middle half of, Grade D, plus or minus 5 percent of whole scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Flo Fab Inc.
d. Marsh Bellofram.

e. Miljoco Corporation.
f. Noshok.
g. Palmer Wahl Instrumentation Group.
h. REOTEMP Instrument Corporation.
i. Tel-Tru Manufacturing Company.
j. Trerice, H. O. Co.
k. Weiss Instruments, Inc.
l. WIKA Instrument Corporation - USA.
m. Winters Instruments - U.S.

3. Standard: ASME B40.100.
4. Case: Sealed type; plastic ; 4-1/2-inch (114-mm), 6-inch (152-mm) nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa), psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass, or, plastic .
11. Accuracy: Grade A, plus or minus 1 percent of middle half of, Grade B, plus or minus 2 percent of middle half of, Grade C, plus or minus 3 percent of middle half of, Grade D, plus or minus 5 percent of whole scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Ernst Flow Industries.
d. Flo Fab Inc.
e. Marsh Bellofram.

f. Miljoco Corporation.
g. Noshok.
h. Palmer Wahl Instrumentation Group.
i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.
k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

3. Standard: ASME B40.100.
4. Case: Liquid-filled, Sealed type; cast aluminum or drawn steel, metal ; 4-1/2-inch (114-mm), 6-inch (152-mm) nominal diameter with back, front flange and holes for panel mounting.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa), psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass, or, plastic .
11. Ring: Metal, Stainless steel .
12. Accuracy: Grade A, plus or minus 1 percent of middle half of, Grade B, plus or minus 2 percent of middle half of, Grade C, plus or minus 3 percent of middle half of, Grade D, plus or minus 5 percent of whole scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMETEK, Inc.; U.S. Gauge.

b. Ashcroft Inc.
c. Miljoco Corporation.
d. Noshok.
e. Palmer Wahl Instrumentation Group.
f. REOTEMP Instrument Corporation.
g. Tel-Tru Manufacturing Company.
h. Trerice, H. O. Co.
i. Weiss Instruments, Inc.
j. WIKA Instrument Corporation - USA.
k. Winters Instruments - U.S.
l. .

3. Standard: ASME B40.100.
4. Case: Sealed type; plastic ; 4-1/2-inch (114-mm), 6-inch (152-mm) nominal diameter with back, front flange and holes for panel mounting.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa), psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass, or, plastic .
11. Accuracy: Grade A, plus or minus 1 percent of middle half of, Grade B, plus or minus 2 percent of middle half of, Grade C, plus or minus 3 percent of middle half of, Grade D, plus or minus 5 percent of whole scale range.

## 2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and piston, porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass, stainless-steel, steel pipe with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15) pipe threads.

C. Valves: Brass ball, Brass or stainless-steel needle, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15), NPS 1/2 (DN 15), ASME B1.20.1 pipe threads.

## 2.6 TEST PLUGS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

C. Description: Test-station fitting made for insertion into piping tee fitting.

D. Body: Brass or stainless steel with core inserts and keted and threaded cap. Include extended stem on units to be installed in insulated piping.

E. Thread Size: NPS 1/4 (DN 8), or, NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C)

G. Core Inserts: Chlorosulfonated polyethylene synthetic, and, EPDM self-sealing rubber.

## 2.7 TEST-PLUG KITS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.
9. .

C. Furnish one test-plug kit(s) containing one, two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

D. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C)

E. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C)

F. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa)

G. Carrying Case: Metal or plastic, with formed instrument padding.

## 2.8 SIGHT FLOW INDICATORS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Archon Industries, Inc.

2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
9. .

C. Description: Piping inline-installation device for visual verification of flow.

D. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel <Insert device> indicator, and threaded or flanged ends.

E. Minimum Pressure Rating: 125 psig (860 kPa), 150 psig (1034 kPa) .

F. Minimum Temperature Rating: 200 deg F (93 deg C) .

G. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

H. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

## 2.9 FLOWMETERS

A. Orifice Flowmeters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Bell & Gossett; ITT Industries.
    c. Meriam Process Technologies.
    d. Preso Meters; a division of Racine Federated Inc.
    e. S. A. Armstrong Limited; Armstrong Pumps Inc.
    f. .

3. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.

    a. Design: Differential-pressure-type measurement for , , , water .
    b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
    c. Minimum Pressure Rating: 300 psig (2070 kPa) .
    d. Minimum Temperature Rating: 250 deg F (121 deg C) .

6. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.

    a. Scale: Gallons per minute (Liters per second).
    b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range .

7. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot (3.7-m) hoses, with carrying case.

    a. Scale: Gallons per minute (Liters per second).
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range .

8. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
9. Conversion Chart: Flow rate data compatible with sensor and indicator.
10. Operating Instructions: Include complete instructions with each flowmeter.

B. Pitot-Tube Flowmeters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Emerson Process Management; Rosemount.

c. Meriam Process Technologies.

d. Preso Meters; a division of Racine Federated Inc.

e. TACO Incorporated.

f. Veris Industries, Inc.

3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute (liters per second).

    a. Design: Differential-pressure-type measurement for , water .
    b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
    c. Minimum Pressure Rating: 150 psig (1035 kPa) .
    d. Minimum Temperature Rating: 250 deg F (121 deg C) .

6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Integral Transformer: For low-voltage power connection.
8. Accuracy: Plus or minus 3 percent.
9. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
10. Operating Instructions: Include complete instructions with each flowmeter.

C. Turbine Flowmeters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Data Industrial Corp.
    c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    d. ERDCO Engineering Corp.
    e. Hoffer Flow Controls, Inc.
    f. Liquid Controls; a unit of IDEX Corporation.
    g. McCrometer, Inc.
    h. Midwest Instruments & Controls Corp.

i. ONICON Incorporated.

j. SeaMetrics, Inc.

k. Sponsler, Inc.; a unit of IDEX Corporation.

l. .

3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute (liters per second).

    a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for , , , water .

    b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.

    c. Minimum Pressure Rating: 150 psig (1035 kPa) .

    d. Minimum Temperature Rating: 180 deg F (82 deg C) .

6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Accuracy: Plus or minus 1-1/2 percent.
8. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
9. Operating Instructions: Include complete instructions with each flowmeter.

D. Venturi Flowmeters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.

    b. Gerand Engineering Co.

    c. Hyspan Precision Products, Inc.

    d. Preso Meters; a division of Racine Federated Inc.

    e. S. A. Armstrong Limited; Armstrong Pumps Inc.

    f. Victaulic Company.

    g. .

3. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.

4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

    a. Design: Differential-pressure-type measurement for , , , water .
    b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
    c. Minimum Pressure Rating: 250 psig (1725 kPa) .
    d. Minimum Temperature Rating: 250 deg F (121 deg C) .
    e. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
    f. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.
    g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

6. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

    a. Scale: Gallons per minute (Liters per second).
    b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range .

7. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses, with carrying case.

    a. Scale: Gallons per minute (Liters per second).
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

8. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
9. Conversion Chart: Flow rate data compatible with sensor.
10. Operating Instructions: Include complete instructions with each flowmeter.

E. Vortex-Shedding Flowmeters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.

b. Eastech Flow Controls.
c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
d. Emerson Process Management; Rosemount.
e. Endress+Hauser.
f. ISTEC Corporation.
g. .

3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute (liters per second).

a. Design: Flow obstruction device, vortex-measurement type
b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
c. Minimum Pressure Rating: 1000 psig (6900 kPa) .
d. Minimum Temperature Rating: 500 deg F (260 deg C) .
e. Integral Transformer: For low-voltage power operation.

6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for es.
8. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
9. Operating Instructions: Include complete instructions with each flowmeter.

## 2.10 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Data Industrial Corp.
b. Hoffer Flow Controls, Inc.
c. ISTEC Corporation.
d. ONICON Incorporated.

3. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
4. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.

    a. Design: Total thermal-energy measurement.
    b. Minimum Pressure Rating: 150 psig (1035 kPa) .
    c. Minimum Temperature Range: 40 to 250 deg F (5 to 121 deg C)

5. Temperature Sensors: Insertion-type transducer.
6. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
    b. Battery Pack: Five-year lithium battery.

7. Accuracy: Plus or minus 1 percent.
8. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).
9. Strainer: Full size of main line piping.
10. Operating Instructions: Include complete instructions with each thermal-energy meter system.

B. Ultrasonic, Thermal-Energy Meters:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    b. Siemens Energy & Automation, Inc.

3. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
4. Flow Sensor: Transit-time ultrasonic type with transmitter.

5. Temperature Sensors: Insertion-type or strap-on transducer.
6. Indicator: Solid-state, integrating-type meter with integral battery pack.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
    b. Battery Pack: Five-year lithium battery.

7. Accuracy: Plus or minus 1 percent.
8. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).
9. Operating Instructions: Include complete instructions with each thermal-energy meter system.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid, one-third of pipe diameter, to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except ).

K. Install valve and syphon fitting in piping for each pressure gage for .

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic ber.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic c in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

## 3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

## 3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

## 3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic ber shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

C. Thermometers at inlets and outlets of each chiller shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.

4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each hydronic c in air-handling units and built-up central systems shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

F. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

G. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

H. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Liquid-filled, Sealed, bimetallic-actuated type.
2. Direct, Remote-mounted, metal, plastic-case, vapor-actuated type.
3. Compact, Industrial-style, liquid-in-glass type.
4. Direct, Remote-mounted, light-activated type.

I. Thermometer stems shall be of length to match thermowell insertion length.

## 3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Chilled-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

C. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

## 3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:

1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief , direct, remote-mounted, metal case.
2. Sealed , direct, remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:

1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief , direct, remote-mounted, metal case.
2. Sealed , direct, remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief , direct, remote-mounted, metal case.
2. Sealed , direct, remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic, EPDM self-sealing rubber inserts.

## 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 30 in. Hg to 15 psi and minus 100 to 0 kPa.

B. Scale Range for Chilled-Water Piping: 0 to 30 psi and 0 to 240 kPa.

C. Scale Range for Chilled-Water Piping: 0 to 100 psi and 0 to 600 kPa.

D. Scale Range for Heating, Hot-Water Piping: 30 in. Hg to 15 psi and minus 100 to 0 kPa.

E. Scale Range for Heating, Hot-Water Piping: 0 to 30 psi and 0 to 240 kPa.

F. Scale Range for Heating, Hot-Water Piping 0 to 100 psi and 0 to 600 kPa.

## 3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Orifice, Pitot-tube, Turbine, Venturi, Vortex-shedding type.

B. Flowmeters for Heating, Hot-Water Piping: Orifice, Pitot-tube, Turbine, Venturi, Vortex-shedding type.

## 3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters for Chilled-Water Piping: Impeller-turbine, Ultrasonic type.

B. Thermal-Energy Meters for Heating, Hot-Water Piping: Impeller-turbine, Ultrasonic type.

**END SECTION**

**SECTION 23 05 23**

**GENERAL-DUTY VALVES FOR HVAC 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. High-performance butterfly valves.
8. Bronze lift check valves.
9. Bronze swing check valves.
10. Iron swing check valves.
11. Iron swing check valves with closure control.
12. Iron, grooved-end swing-check valves.
13. Iron, center-guided check valves.
14. Iron, plate-type check valves.
15. Bronze gate valves.
16. Iron gate valves.
17. Bronze globe valves.
18. Iron globe valves.
19. Lubricated plug valves.
20. Eccentric plug valves.
21. Chainwheels.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

## 1.4 ACTION 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.

## 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 HVAC 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 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5, 10 plug valves, for each size square plug-valve head.
5. 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 (50-mm) 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 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

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. Hammond Valve.
b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

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. American Valve, Inc.
    b. NIBCO INC.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: PTFE or TFE.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Stockham Division.
    b. Kitz Corporation

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem and Disc: Bronze.
    f. Packing: Asbestos free.
    g. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Powell Valves.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig (2070 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

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. Kitz Corporation.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. DynaQuip Controls.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.
h. Kitz Corporation.
i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).

c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
d. Hammond Valve.
e. Jamesbury; a subsidiary of Metso Automation.
f. Kitz Corporation.
g. Marwin Valve; a division of Richards Industries.
h. Milwaukee Valve Company.
i. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two 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.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

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. Hammond Valve.
b. Jamesbury; a subsidiary of Metso Automation.
c. Legend Valve.
d. Marwin Valve; a division of Richards Industries.
e. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).

d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

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. Jamesbury; a subsidiary of Metso Automation.
b. Marwin Valve; a division of Richards Industries.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Brass or bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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. Jomar International, LTD.
b. Kitz Corporation.
c. Red-White Valve Corporation.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

G. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.

2. Description:

    a. Standard: MSS SP-110.
    b. SWP Rating: 150 psig (1035 kPa).
    c. CWP Rating: 600 psig (4140 kPa).
    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.

## 2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. NIBCO INC.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 400 psig (2760 kPa).
    c. Body Design: One piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Bronze.
    h. Ball: Chrome-plated brass.
    i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
    b. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. DynaQuip Controls.
f. Hammond Valve.
g. Lance Valves; a division of Advanced Thermal Systems, Inc.
h. Milwaukee Valve Company.
i. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.

f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

## 2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

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. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Kitz Corporation.
d. Sure Flow Equipment Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

## 2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
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. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.

n. Spence Strainers International; a division of CIRCOR International.
o. Tyco Valves & Controls; a unit of Tyco Flow Control.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
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: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
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. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.
n. Spence Strainers International; a division of CIRCOR International.
o. Tyco Valves & Controls; a unit of Tyco Flow Control.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
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: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

C. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Spence Strainers International; a division of CIRCOR International.
n. Sure Flow Equipment Inc.
o. Tyco Valves & Controls; a unit of Tyco Flow Control.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
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: Nickel-plated or -coated ductile iron.

D. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Spence Strainers International; a division of CIRCOR International.
n. Sure Flow Equipment Inc.
o. Tyco Valves & Controls; a unit of Tyco Flow Control.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).

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: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or -coated ductile iron.

E. 150 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
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. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.
n. Spence Strainers International; a division of CIRCOR International.
o. Sure Flow Equipment Inc.
p. Tyco Valves & Controls; a unit of Tyco Flow Control.
q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
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.

F. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
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. Hammond Valve.

i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.
n. Spence Strainers International; a division of CIRCOR International.
o. Sure Flow Equipment Inc.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
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: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

G. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Flo Fab Inc.
h. Hammond Valve.
i. Kitz Corporation.
j. Legend Valve.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Norriseal; a Dover Corporation company.
n. Red-White Valve Corporation.
o. Spence Strainers International; a division of CIRCOR International.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
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: Aluminum bronze.

H. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Flo Fab Inc.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Legend Valve.
    k. Milwaukee Valve Company.
    l. NIBCO INC.
    m. Norriseal; a Dover Corporation company.
    n. Red-White Valve Corporation.
    o. Spence Strainers International; a division of CIRCOR International.
    p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    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: NBR.
    f. Stem: One- or two-piece stainless steel.
    g. Disc: Aluminum bronze.

I. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

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. 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; Center Line.
    f. Crane Co.; Crane Valve Group; Stockham Division.
    g. DeZurik Water Controls.
    h. Flo Fab Inc.
    i. Hammond Valve.
    j. Kitz Corporation.
    k. Legend Valve.
    l. Milwaukee Valve Company.
    m. NIBCO INC.
    n. Norriseal; a Dover Corporation company.
    o. Spence Strainers International; a division of CIRCOR International.
    p. Sure Flow Equipment Inc.
    q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
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: Nickel-plated or -coated ductile iron.

J. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

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. 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; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. NIBCO INC.
n. Norriseal; a Dover Corporation company.
o. Spence Strainers International; a division of CIRCOR International.
p. Sure Flow Equipment Inc.
q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
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: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or -coated ductile iron.

K. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. NIBCO INC.
n. Norriseal; a Dover Corporation company.
o. Red-White Valve Corporation.
p. Spence Strainers International; a division of CIRCOR International.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
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.

L. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

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. 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. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. NIBCO INC.
n. Norriseal; a Dover Corporation company.
o. Red-White Valve Corporation.
p. Spence Strainers International; a division of CIRCOR International.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).

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: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

## 2.7 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

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. Kennedy Valve; a division of McWane, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig (1200 kPa).
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

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. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. NIBCO INC.
d. Shurjoint Piping Products.
e. Tyco Fire Products LP; Grinnell Mechanical Products.
f. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. NPS 8 (DN 50) and Smaller CWP Rating: 300 psig (2070 kPa).
c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
d. Body Material: Coated, ductile iron.
e. Stem: Two-piece stainless steel.
f. Disc: Coated, ductile iron.
g. Seal: EPDM.

## 2.8 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   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 (1965 kPa) at 100 deg F (38 deg C).
   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.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

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. 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: 720 psig (4965 kPa) at 100 deg F (38 deg C).
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, or ductile iron.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

## 2.9 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 offering products that may be incorporated into the Work include, but are not limited to, the following:

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 (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

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. Flo Fab Inc.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

## 2.10 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. 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. Hammond Valve.
    f. Kitz Corporation.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Powell Valves.
    j. Red-White Valve Corporation.
    k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    l. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Kitz Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Red-White Valve Corporation.
    i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

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. 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. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Red-White Valve Corporation.
   i. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: PTFE or TFE.

## 2.11 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Sure Flow Equipment Inc.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
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.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Composition.
h. Seat Ring: Bronze.
i. Disc Holder: Bronze.
j. Disc: PTFE or TFE.
k. Gasket: Asbestos free.

C. 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 offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. 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 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
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.

## 2.12 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

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. NIBCO INC.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
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.
i. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. 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 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
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.
i. Closure Control: Factory-installed, exterior lever and weight.

## 2.13 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

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. Anvil International, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig (2070 kPa).
b. Body Material: ASTM A 536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

## 2.14 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

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. Anvil International, Inc.
b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. Flo Fab Inc.
f. GA Industries, Inc.
g. Hammond Valve.
h. Metraflex, Inc.
i. Milwaukee Valve Company.
j. NIBCO INC.
k. Spence Strainers International; a division of CIRCOR International.
l. Sure Flow Equipment Inc.
m. Val-Matic Valve & Manufacturing Corp.

n. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer.
f. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Spence Strainers International; a division of CIRCOR International.
j. Sure Flow Equipment Inc.
k. Val-Matic Valve & Manufacturing Corp.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).

d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Compact wafer.
f. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer, spring loaded.
f. Seat: Bronze.

F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Compact wafer, spring loaded.
f. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Spence Strainers International; a division of CIRCOR International.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer.
f. Seat: EPDM, or, NBR .

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

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. Anvil International, Inc.
b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. GA Industries, Inc.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.

g. Seat: EPDM, or, NBR .

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Compact wafer.
f. Seat: EPDM, or, NBR .

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: EPDM, or, NBR .

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.

h. Sure Flow Equipment Inc.
i. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer, spring loaded.
f. Seat: EPDM, or, NBR .

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 126, gray iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: EPDM, or, NBR .

O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Compact wafer, spring loaded.
f. Seat: EPDM, or, NBR .

P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
   d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   e. Style: Globe, spring loaded.
   f. Ends: Flanged.
   g. Seat: EPDM, or, NBR .

## 2.15 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Flomatic Corporation.

2. Description:

   a. Standard: API 594.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
   d. Body Design: Wafer, spring-loaded plates.
   e. Body Material: ASTM A 126, gray iron.
   f. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: API 594.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: Bronze.

C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 126, gray iron.
f. Seat: Bronze.

D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: Bronze.

E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

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. Flo Fab Inc.
b. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Wafer, spring-loaded plate.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM, or, NBR .

F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Cooper Cameron Valves TVB Techno.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. NIBCO INC.
f. Spence Strainers International; a division of CIRCOR International.
g. Sure Flow Equipment Inc.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM, or, NBR .

G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: EPDM, or, NBR .

H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

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. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Design: Wafer, spring-loaded plate.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM, or, NBR .

I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM, or, NBR .

J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: EPDM, or, NBR .

## 2.16 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

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. 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. Hammond Valve.
    f. Kitz Corporation.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Powell Valves.
    j. Red-White Valve Corporation.
    k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    l. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded or solder joint.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

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. 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. Hammond Valve.
    f. Kitz Corporation.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Powell Valves.
    j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    k. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded or solder joint.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, NRS Bronze Gate Valves:

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. 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.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 300 psig (2070 kPa).
    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.

D. Class 150, RS Bronze Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. Hammond Valve.
    d. Kitz Corporation.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Powell Valves.
    h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    i. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig (2070 kPa).
    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.

## 2.17 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Kitz Corporation.
    g. Legend Valve.
    h. Milwaukee Valve Company.
    i. NIBCO INC.
    j. Powell Valves.
    k. Red-White Valve Corporation.
    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    m. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-70, Type I.
    b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
    c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
    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 125, OS&Y, Iron Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Flo Fab Inc.
    e. Hammond Valve.
    f. Kitz Corporation.
    g. Legend Valve.
    h. Milwaukee Valve Company.
    i. NIBCO INC.
    j. Powell Valves.
    k. Red-White Valve Corporation.
    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
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.

C. Class 250, NRS, Iron Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
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.

D. Class 250, OS&Y, Iron Gate Valves:

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. 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.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
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.

## 2.18 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. Hammond Valve.
    d. Kitz Corporation.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Powell Valves.
    h. Red-White Valve Corporation.
    i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    j. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded or solder joint.
    e. Stem and Disc: Bronze.
    f. Packing: Asbestos free.
    g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. NIBCO INC.
    d. Red-White Valve Corporation.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded or solder joint.
    e. Stem: Bronze.
    f. Disc: PTFE or TFE.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Hammond Valve.
    c. Kitz Corporation.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Powell Valves.
    g. Red-White Valve Corporation.
    h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    i. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig (2070 kPa).
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: PTFE or TFE.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.19 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Kitz Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Powell Valves.
    i. Red-White Valve Corporation.
    j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    k. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-85, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

## 2.20 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

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. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

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. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:

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. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

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. Homestead Valve; a division of Olson Technologies, Inc.

b. Milliken Valve Company.
c. R & M Energy Systems, a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
e. Pattern: Regular or short, Venturi .
f. Plug: Cast iron or bronze with sealant groove.

## 2.21 ECCENTRIC PLUG VALVES

A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

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. Clow Valve Co.; a division of McWane, Inc.
b. DeZurik Water Controls.
c. Homestead Valve; a division of Olson Technologies, Inc.
d. M&H Valve Company; a division of McWane, Inc.
e. Milliken Valve Company.
f. Henry Pratt Company.
g. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-108.
b. CWP Rating: 175 psig (1200 kPa) minimum.
c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
d. Bearings: Oil-impregnated bronze or stainless steel.
e. Ends: Flanged.
f. Stem-Seal Packing: Asbestos free.
g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

## 2.22 CHAINWHEELS

A. 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:
1. Roto Hammer Industries.
2. 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 ball, butterfly, and, plug valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, Ductile or cast iron, Cast iron, Aluminum, Bronze, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, Brass, Stainless 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.

E. Install chainwheels on operators for ball, butterfly, gate, globe, and, plug valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) 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. Center-Guided, and, Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

### 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, , gate, or plug valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Pump-Discharge Check Valves:

    a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze, or, nonmetallic disc.
    b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal, or, resilient-seat check valves.

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 (DN 50) 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 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

## 3.5 CHILLED-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. Bronze Angle Valves: Class 125, Class 150, bronze, nonmetallic disc.
3. Ball Valves: One, Two, Three piece, full, regular, reduced port, brass, or, bronze with brass, bronze, stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, Class 150, bronze, nonmetallic disc.
5. Bronze Gate Valves: Class 125, Class 150, NRS, RS, bronze.
6. Bronze Globe Valves: Class 125, Class 150, bronze, nonmetallic disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175, 300 CWP.
6. High-Performance Butterfly Valves: Class 150, Class 300, single flange.
7. Iron Swing Check Valves: Class 125, Class 250, metal, nonmetallic-to-metal seats.

8. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring, weight.
9. Iron, Grooved-End Check Valves, NPS 3 to NPS 12 (DN 80 to DN 300): 300 CWP.
10. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250, Class 300, compact-wafer, globe, metal, resilient seat.
11. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250, Class 300; single, dual plate; metal, resilient seat.
12. Iron Gate Valves: Class 125, Class 250, NRS, OS&Y.
13. Iron Globe Valves: Class 125, Class 250.
14. Lubricated Plug Valves: Class 125, Class 250, regular gland, cylindrical, threaded, flanged.
15. Eccentric Plug Valves: 175 CWP, resilient seating.

**3.6** CONDENSER-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. Bronze Angle Valves: Class 125, Class 150, bronze, nonmetallic disc.
3. Ball Valves: One, Two, Three piece, full, regular, reduced port, brass, or, bronze with brass, bronze, stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, Class 150, bronze, nonmetallic disc.
5. Bronze Gate Valves: Class 125, Class 150, NRS, RS.
6. Bronze Globe Valves: Class 125, Class 150, bronze, nonmetallic disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175, 300 CWP.
6. High-Performance Butterfly Valves: Class 150, Class 300, single flange.
7. Iron Swing Check Valves: Class 125, Class 250, metal, nonmetallic-to-metal seats.
8. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring, weight.
9. Iron, Grooved-End Check Valves, NPS 3 to NPS 12 (DN 80 to DN 300): 300 CWP.
10. Iron, Center-Guided Check Valves, NPS 2-1/2 to NPS 24 (DN 65 to DN 600): Class 125, Class 150, Class 250, Class 300, metal, resilient seat.
11. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250, Class 300; single, dual plate; metal, resilient seat.
12. Iron Gate Valves: Class 125, Class 250, NRS, OS&Y.
13. Iron Globe Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, Class 250.
14. Lubricated Plug Valves: Class 125, Class 250, regular gland, cylindrical, threaded, flanged.

## 3.7 HEATING-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. Bronze Angle Valves: Class 125, Class 150, bronze, nonmetallic disc.
3. Ball Valves: One, Two, Three piece, full, regular, reduced port, brass, or, bronze with brass, bronze, stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, Class 150, bronze, nonmetallic disc.
5. Bronze Gate Valves: Class 125, Class 150, NRS, RS.
6. Bronze Globe Valves: Class 125, Class 150, bronze, nonmetallic disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM, NBR seat, aluminum-bronze, ductile-iron, stainless-steel disc.
5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175, 300 CWP.
6. High-Performance Butterfly Valves: Class 150, Class 300, single flange.
7. Iron Swing Check Valves: Class 125, Class 250, metal, nonmetallic-to-metal seats.
8. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring, weight.
9. Iron, Grooved-End Check Valves, NPS 3 to NPS 12 (DN 80 to DN 300): 300 CWP.
10. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250, Class 300, compact-wafer, globe, metal, resilient seat.
11. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250, Class 300; single, dual plate; metal, resilient seat.
12. Iron Gate Valves: Class 125, Class 250, NRS, OS&Y.
13. Iron Globe Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, Class 250.

END SECTION

## SECTION 23 05 29

## HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct hangers and supports.

#### 1.03 PERFORMANCE REQUIREMENTS

A. 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.

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.

#### 1.04 ACTION 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. Pipe stands.
4. Equipment supports.

#### 1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

## 1.06 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

# PART 2 PRODUCTS

## 2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.

## 2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.03 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

## 2.04 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic 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: Plastic 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-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.

**2.05 EQUIPMENT SUPPORTS**

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

**2.06 MISCELLANEOUS MATERIALS**

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

**PART 3 EXECUTION**

**3.01 HANGER AND SUPPORT INSTALLATION**

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. 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 Section 077200 "Roof Accessories" for curbs.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. 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.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

M. 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 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.

**3.02 EQUIPMENT SUPPORTS**

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

**3.03 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.

## 3.04 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 required.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.05 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), 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.

I. 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.

J. 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.

K. 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-joist 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.

L. 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.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION**

**SECTION 23 05 53**

**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

### 1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F .
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

**2.02 PIPE LABELS**

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover 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; also include 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: [Size letters according to ASME A13.1 for piping At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

**2.03 STENCILS**

A. Stencils for Piping:

1. Lettering Size: [Size letters according to ASME A13.1 for piping At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances].
2. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
3. .

**2.04 VALVE TAGS**

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

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.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

**3.02 GENERAL INSTALLATION REQUIREMENTS**

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.

**3.03 EQUIPMENT LABEL INSTALLATION**

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

**3.04 PIPE LABEL INSTALLATION**

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Pipe Label Locations: 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 and on both sides of 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. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

**3.05 VALVE-TAG INSTALLATION**

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
    a. Refrigerant: 2 inches, square.
    b. Hot Water: 2 inches, square.
    c. Gas: 2 inches, square.
2. Valve-Tag Colors:
    a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
    b. Flammable Fluids: Black letters on a safety-yellow background.

c. Combustible Fluids: White letters on a safety-brown background.

d. Potable and Other Water: White letters on a safety-green background.

e. Compressed Air: White letters on a safety-blue background.

f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

**END OF SECTION**

## SECTION 23 05 93

## TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

b. Induction-unit systems.

#### 1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

#### 1.05 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or, TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or, TABB.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or, TABB as a TAB technician.

B. TAB Conference: Meet with Architect, Owner, Construction Manager, Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of

the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:
    a. The Contract Documents examination report.
    b. The TAB plan.
    c. Coordination and cooperation of trades and subcontractors.
    d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

**1.06 PROJECT CONDITIONS**

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

**1.07 COORDINATION**

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

**PART 2 PRODUCTS (Not Applicable)**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.

3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.

5. Balance, smoke, and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

## 3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

## 3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

## 3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

## 3.06 PROCEDURES FOR INDUCTION-UNIT SYSTEMS

A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.

B. Adjust each induction unit.

## 3.07 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

**3.08 PROCEDURES FOR CONDENSING UNITS**

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

**3.09 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

## 3.10 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.

2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating-Water Flow Rate: Plus or minus 10 percent.

4. Cooling-Water Flow Rate: Plus or minus 10 percent.

## 3.11 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

## 3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB contractor.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches , and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.

j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches , and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Filter static-pressure differential in inches wg.

f. Preheat-coil static-pressure differential in inches wg.

g. Cooling-coil static-pressure differential in inches wg.

h. Heating-coil static-pressure differential in inches wg.

i. Outdoor airflow in cfm.

j. Return airflow in cfm.

k. Outdoor-air damper position.

l. Return-air damper position.

m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.

b. Location.

c. Coil type.

d. Number of rows.

e. Fin spacing in fins per inch o.c.

f. Make and model number.

g. Face area in sq. ft..

h. Tube size in NPS.

i. Tube and fin materials.

j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.

b. Average face velocity in fpm.

c. Air pressure drop in inches wg.

d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btu/h.
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches , and bore.
   n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Entering-air temperature in deg F.
   c. Leaving-air temperature in deg F.
   d. Air temperature differential in deg F.
   e. Entering-air static pressure in inches wg.
   f. Leaving-air static pressure in inches wg.
   g. Air static-pressure differential in inches wg.
   h. Low-fire fuel input in Btu/h.
   i. High-fire fuel input in Btu/h.

j. Manifold pressure in psig.

k. High-temperature-limit setting in deg F.

l. Operating set point in Btu/h.

m. Motor voltage at each connection.

n. Motor amperage for each phase.

o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.

b. Location.

c. Coil identification.

d. Capacity in Btu/h.

e. Number of stages.

f. Connected volts, phase, and hertz.

g. Rated amperage.

h. Air flow rate in cfm.

i. Face area in sq. ft..

j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.

b. Air flow rate in cfm.

c. Air velocity in fpm.

d. Entering-air temperature in deg F.

e. Leaving-air temperature in deg F.

f. Voltage at each connection.

g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches , and bore.

h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches , and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.

b. Location and zone.

c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.

e. Duct size in inches.

f. Duct area in sq. ft..

g. Indicated air flow rate in cfm.

h. Indicated velocity in fpm.

i. Actual air flow rate in cfm.

j. Actual average velocity in fpm.

k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.

b. Location and zone.

c. Apparatus used for test.

d. Area served.

e. Make.

f. Number from system diagram.

g. Type and model number.

h. Size.

i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.

b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.
    c. Actual impeller size in inches.
    d. Full-open flow rate in gpm.
    e. Full-open pressure in feet of head or psig.
    f. Final discharge pressure in feet of head or psig.
    g. Final suction pressure in feet of head or psig.
    h. Final total pressure in feet of head or psig.
    i. Final water flow rate in gpm.
    j. Voltage at each connection.
    k. Amperage for each phase.

N. Instrument Calibration Reports:
1. Report Data:
    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

**3.13 INSPECTIONS**

A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Verify that balancing devices are marked with final balance position.
    e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

**3.14 ADDITIONAL TESTS**

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION**

## SECTION 23 07 13
## DUCT INSULATION

### PART 1 - GENERAL

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, concealed supply and return.
   6. Outdoor, exposed supply and return.

**1.03 ACTION SUBMITTALS**

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor performance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
   2. Sheet Jacket Materials: 12 inches (300 mm) square.
   3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

**1.04 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

**1.05 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

**1.06 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.

## 1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

## 1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

# PART 2 - PRODUCTS

## 2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

a.

## 2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.03 MASTICS**

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
   2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
   4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
   2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

**2.04 LAGGING ADHESIVES**

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   3. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   4. Color: White.

**2.05 SEALANTS**

A. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   4. Color: Aluminum.
   5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   4. Color: White.
   5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.06 FACTORY-APPLIED JACKETS**

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

**2.07 FIELD-APPLIED FABRIC-REINFORCING MESH**

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

**2.08 FIELD-APPLIED CLOTHS**

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

**2.09 FIELD-APPLIED JACKETS**

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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. Adhesive: As recommended by jacket material manufacturer.
   2. Color: Color as selected by Architect.

D. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
   2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper 2.5-mil- (0.063-mm-) thick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white stucco-embossed aluminum-foil facing.

**2.10 TAPES**

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. 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. Width: 3 inches (75 mm).
2. Thickness: 6.5 mils (0.16 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. 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. Width: 2 inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

**2.11 SECUREMENTS**

A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) 3/4 inch (19 mm) wide with wing seal or closed seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) 3/4 inch (19 mm) wide with wing seal or closed seal.
3. 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, 0.106-inch- (2.6-mm-) 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) 0.135-inch- (3.5-mm-)

diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel Aluminum Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy 0.062-inch (1.6-mm) soft-annealed, stainless steel 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

**2.12 CORNER ANGLES**

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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

### 3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 4 inches (100 mm) o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

## 3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## 3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

## 3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
      b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 50 <Insert number> percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
   b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

**3.07 FIELD-APPLIED JACKET INSTALLATION**

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) 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 (50-mm) 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 (300 mm) o.c. and at end joints.

**3.08 FIRE-RATED INSULATION SYSTEM INSTALLATION**

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

**C.** Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

**3.09 FINISHES**

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

## 3.10 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 ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, concealed supply and return.
   6. Outdoor, exposed supply and return.
B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.
   5. Flexible connectors.
   6. Vibration-control devices.
   7. Factory-insulated access panels and doors.

## 3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
C. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
D. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
F. Concealed, rectangular, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
   2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
G. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
   2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
H. Concealed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

I. Concealed, return-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

J. Concealed, outdoor-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

**3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE**

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

C. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

D. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

F. Concealed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

G. Concealed, supply-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

H. Concealed, return-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

I. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

J. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

K. Exposed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

L. Exposed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

M. Exposed, supply-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

N. Exposed, return-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

**3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
1. None.

D. Ducts and Plenums, Exposed:
1. None.

**3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
1. PVC : 20 mils (0.5 mm) thick.
2. Aluminum, Corrugated : 0.024 inch (0.61 mm) thick.
3. Painted Aluminum, Corrugated : 0.024 inch (0.61 mm) thick.
4. Stainless Steel, Type 304 or Type 316, Corrugated : 0.024 inch (0.61 mm) thick.

D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. Aluminum, Corrugated : 0.024 inch (0.61 mm) thick.
2. Painted Aluminum, Corrugated: 0.024 inch (0.61 mm) thick.
3. Stainless Steel, Type 304 or Type 316, Corrugated : 0.024 inch (0.61 mm) thick.

E. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. Painted Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations 0.032 inch (0.81 mm) thick.
2. Stainless Steel, Type 304 or Type 316, Smooth , with 1-1/4-Inch- (32-mm-) Deep Corrugations 0.024 inch (0.61 mm) thick.

**END OF SECTION**

SECTION 23 07 16

HVAC EQUIPMENT 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 insulating the following HVAC equipment that is not factory insulated:

1. Chillers.
2. Chilled-water pumps.
3. Dual-service heating and cooling pumps.
4. Heating, hot-water pumps.
5. Expansion/compression tanks.
6. Air separators.
7. Thermal storage tanks.
8. Piping system filtration unit housings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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 removable insulation at equipment connections.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

## 1.5 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 1.6 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.

## 1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

## 1.8 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. 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.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Calcium Silicate:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Industrial Insulation Group (IIG); Thermo-12 Gold.

2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

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. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Sheet and K-FLEX LS.

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 II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.

e. Owens Corning; SOFTR All-Service Duct Wrap.

I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
b. Johns Manville; HTB 26 Spin-Glas.
c. Roxul Inc.; Roxul RW.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; CertaPro 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.

K. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; FBX.Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
b. Rock Wool; Delta Board.
c. Roxul Inc.; RHT and RockBoard.
d. Thermafiber, Inc.; Thermafiber Industrial Felt.

L. 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 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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.

M. Phenolic:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
    b. Resolco International BV; Insul-phen.

2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
4. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

N. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Chemical Company (The); Trymer 2000 XP.
    b. Duna USA Inc.; Corafoam.
    c. Dyplast Products; ISO-25.
    d. Elliott Company of Indianapolis; Elfoam.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1 inch (25 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

    a. Equipment Applications: ASJ.

O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armacell LLC; Tubolit.
    b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

P. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Chemical Company (The); Styrofoam.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
b. - Marathon Industries; 290.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
d. Mon-Eco Industries, Inc.; 22-30.
e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA, Inc.; Aeroseal.
    b. Armacell LLC; Armaflex 520 Adhesive.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

H. 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.

b. - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M 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, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M 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, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

7. 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, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering equipment.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

## 2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White Color-code jackets based on system. Color as selected by Architect.
4. Factory-fabricated tank heads and tank side panels.

D. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white stucco-embossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Polyguard Products, Inc.; Alumaguard 60.

E. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.

F. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.

G. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.11 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).
3. Film Thickness: 4 mils (0.10 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal 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, 0.106-inch- (2.6-mm-) 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, Series.
2) GEMCO; Peel & Press.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel Aluminum Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel aluminum stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. 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:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy

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 & F Wire.

## 2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), 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 tolerances 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.

B. 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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) 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.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

## 3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

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 (75 mm) from insulation end joints, and 16 inches (400 mm) 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.
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 (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) 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 (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
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. Wrap pump body (not motor) in Armaflex.

## 3.5 INSTALLATION OF PHENOLIC INSULATION

A. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

B. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

## 3.6 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) 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 (50-mm) 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 (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) 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.
2. 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.

## 3.7 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

## 3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

## 3.9 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 that is not factory insulated.

C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, heat-recovery bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Flexible Elastomeric: 1 inch (25 mm) thick.
3. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
5. Phenolic: 1 inch (25 mm) thick.
6. Polyisocyanurate: 1 inch (25 mm) thick.
7. Polyolefin: 1 inch (25 mm) thick.

D. Chilled-water pump insulation shall be one of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. mnominal density.
3. Phenolic: 2 inches (50 mm) thick.

E. Dual-service heating and cooling pump insulation shall be one of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Phenolic: 2 inches (50 mm) thick.

F. Heating-hot-water pump insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Cellular Glass: 3 inches (75 mm) thick.
3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

G. Dual-service heating and cooling expansion/compression tank insulation shall be one of the following:

1. Cellular Glass: 2 inch (50 mm) thick.thick.
2. Flexible Elastomeric: 2 inch (50 mm) thick.
3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
4. Phenolic: 2 inches (50 mm) thick.

H. Dual-service heating and cooling air-separator insulation shall be one of the following:

1. Cellular Glass: 2 inch (50 mm) thick.thick.
2. Flexible Elastomeric: 2 inch (50 mm) thick.thick.
3. Mineral-Fiber Board: 2 inch (50 mm) thick.thick and 3-lb/cu. ft. (48-kg/cu. m nominal density.
4. Mineral-Fiber Pipe and Tank: 2 inch (50 mm) thick.thick.
5. Phenolic: 2 inch (50 mm) thick.thick.

I. Piping system filter-housing insulation shall be one of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

## 3.10 NDOOR, 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. PVC : 20 mils (0.5 mm) thick.

D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. PVC : 20 mils (0.5 mm) thick.

END OF SECTION 230716

**SECTION 230719**
**HVAC PIPING 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 insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors, and, outdoors.
   2. Chilled-water and brine piping, indoors, and, outdoors.
   3. Heating hot-water piping, indoors, and, outdoors.
   4. Refrigerant suction and hot-gas piping, indoors, and, outdoors.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   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.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
   1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
   2. Sheet Form Insulation Materials: 12 inches (300 mm) square.
   3. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
   4. Sheet Jacket Materials: 12 inches (300 mm) square.
   5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

### 1.5 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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 (3-m) section of NPS 2 (DN 50) 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 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) 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. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

**1.6 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.

**1.7 COORDINATION**

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

**1.8 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation 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. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide the following :
    a. Industrial Insulation Group (IIG); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. 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 the following :
a. Pittsburgh Corning Corporation; Foamglas.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ, ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide the following :
a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

I. 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, II with factory-applied vinyl jacket, III with factory-applied FSK jacket, III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following :
a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide the following :
a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket, with factory-applied ASJ, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, without factory-applied jacket, with factory-applied ASJ, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with

self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products: Subject to compliance with requirements, provide the following :
    a. Knauf Insulation; Permawick Pipe Insulation.
    b. Owens Corning; VaporWick Pipe Insulation.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ, FSK jacket 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 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide 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.

M. Phenolic:

1. Products: Subject to compliance with requirements, provide the following :
    a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
    b. Resolco International BV; Insul-phen.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    a. Preformed Pipe Insulation: ASJ.

N. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, provide the following :
    a. Dow Chemical Company (The); Trymer 2000 XP.
    b. Duna USA Inc.; Corafoam.
    c. Dyplast Products; ISO-25.
    d. Elliott Company of Indianapolis; Elfoam.
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thickness up to 1 inch (25 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    a. Pipe Applications: ASJ, ASJ-SSL, PVDC, PVDC-SSL.

O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide the following :
    a. Armacell LLC; Tubolit.
    b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

P. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide the following :
    a. Dow Chemical Company (The); Styrofoam.

## 2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
   1. Products: Subject to compliance with requirements, provide the following :
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
      b. - Marathon Industries; 290.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
      d. Mon-Eco Industries, Inc.; 22-30.
      e. Vimasco Corporation; 760.
   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
   1. Products: Subject to compliance with requirements, provide the following :
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
   1. Products: Subject to compliance with requirements, provide the following :
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide the following :
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).
1. Products: Subject to compliance with requirements, provide the following :
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

H. 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 the following :
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following :
a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 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 the following :
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
      b. - Marathon Industries; 501.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
      d. Mon-Eco Industries, Inc.; 55-10.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
   4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
   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 the following :
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
      b. - Marathon Industries; 570.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   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 the following :
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
      b. - Marathon Industries; 550.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
      d. Mon-Eco Industries, Inc.; 55-50.
      e. Vimasco Corporation; WC-1/WC-5.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   4. Solids Content: 60 percent by volume and 66 percent by weight.
   5. Color: White.

## 2.5 LAGGING

**A.** APPROVED MANUFACTURERS

**1.** Kinetics Noise Control, Dublin, OH – www.kineticsnoise.com
**2.** Wilrep Ltd., Mississauga, Ontario – www.wilrep.com
**3.** Sound Seal, Agawam, MA – www.soundseal.com
**4.** Great Lakes Textiles, Walton Hills, OH – www.gltproducts.com
**5.** Bradford Industries, Lowell, MA – www.bradfordind.com

**B.** DESCRIPTION OF PRODUCTS

**1.** Pipe/duct lagging material shall be comprised of an insulating decoupling wrap or batting with a mass-loaded vinyl or other non-porous material barrier layer. Barrier layer shall not be directly adhered to or contact the lagged pipe/duct.
**2.** Provide multiple layers of pipe/duct lagging material or heavier weight material on pipes/ducts specifically identified on the contract drawings, or in order to achieve the minimum specified weight.
**3.** Barrier products may be provided with integrated decoupling product, else provide duct wrap/pipe insulation as specified herein.
**4.** Insulating Decoupling Wrap/Batting
   a. Barrier material shall be separated from the duct or pipe with a glass fiber or foam decoupling layer.
   b. Product shall have a minimum thickness of 2 inches (50mm) unless indicated elsewhere.
   c. Product shall have a minimum density of 2 pounds per cubic foot (32 kg/m$^3$) unless indicated elsewhere.

5. Mass-loaded Vinyl Barrier
   a. Product shall be a flexible, mass-loaded vinyl sheet.
   b. Surface density shall be minimum 2 pounds per square foot (9.7 kg/m$^2$) unless indicated elsewhere.
      1) Multiple layers of lighter weight products is acceptable provided the composite weight of the layers is equal to or greater than the minimum specified surface density.
6. Flammability: SE “0” in/min.
7. Acceptable Products
   a. KNM-200B (Kinetics)
   b. Barymat 5 (Wilrep)
   c. B-20 Lag (Sound Seal)
   d. Vinaflex VP-200 (Great Lakes Textiles)
   e. 20NL Coustifilm (Bradford)

## 2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following :
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide the following :
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.

d. Mon-Eco Industries, Inc.; 44-05.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following :
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.
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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following :
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M 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 the following :
1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M 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 the following :
1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

7. 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 the following :
1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perms) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

**2.8 FIELD-APPLIED FABRIC-REINFORCING MESH**

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide the following :
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, provide the following :
a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

**2.9 FIELD-APPLIED CLOTHS**

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide the following :
a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

**2.10 FIELD-APPLIED JACKETS**

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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 the following :
a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White, Color-code jackets based on system. Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   a. Sheet and roll stock ready for shop or field sizing, Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper, 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, 2.5-mil- (0.063-mm-) thick polysurlyn.
   d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, 2.5-mil- (0.063-mm-) thick polysurlyn.
   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.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
   a. Sheet and roll stock ready for shop or field sizing, Factory cut and rolled to size.
   b. Material, finish, and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper, 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, 2.5-mil- (0.063-mm-) thick polysurlyn.
   d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, 2.5-mil- (0.063-mm-) thick polysurlyn.
   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.

E. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) 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 the following :
      a. Pittsburgh Corning Corporation; Pittwrap.
      b. Polyguard Products, Inc.; Insulrap No Torch 125.

F. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white, stucco-embossed aluminum-foil facing.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Polyguard Products, Inc.; Alumaguard 60.

G. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.

H. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Dow Chemical Company (The); Saran 560 Vapor Retarder Film.

I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
   1. Products: Subject to compliance with requirements, provide the following :
      a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

**2.11 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 the following :
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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 the following :
      a. ABI, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 6.5 mils (0.16 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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 the following :
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches (50 mm).
   3. Thickness: 6 mils (0.15 mm).
   4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following :
a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following :
a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 4 mils (0.10 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following :
a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

## 2.12 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide the following :
a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304, or, Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm), 3/4 inch (19 mm) wide with wing seal, or, closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm), 3/4 inch (19 mm) wide with wing seal, 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
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. C & F Wire.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems 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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) 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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm), 4 inches (100 mm) o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, 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.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. 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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
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 Section 078413 "Penetration Firestopping" for firestopping 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 Section 078413 "Penetration Firestopping."

## 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

## 3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

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 block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

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 insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

## 3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

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 (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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 (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

## 3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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 INSTALLATION OF MINERAL-FIBER INSULATION

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.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, 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 (25 mm), 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 INSTALLATION OF PHENOLIC INSULATION**

A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. 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 (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. 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 block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
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.

## 3.11 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
   2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
   3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of polyisocyanurate 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.

## 3.12 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet 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.
   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.

## 3.13 INSTALLATION OF POLYSTYRENE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, and make thickness same as adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm).
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed section of polystyrene 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.

**3.14 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. 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 (50-mm) 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 (300 mm) 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-presized 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 (50 mm) 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 (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) 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.

**3.15 FINISHES**

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.
B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

**3.16 FIELD QUALITY CONTROL**

A. Testing Agency: Owner will engage, Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

**3.17 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.

**3.18 INDOOR PIPING INSULATION SCHEDULE**

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 1-1/2 inches (38 mm) thick.
      b. Flexible Elastomeric: 3/4 inch (19 mm), 1 inch (25 mm) thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm), 1 inch (25 mm) thick.
      d. Phenolic: 1 inch (25 mm) thick.
      e. Polyisocyanurate: 1 inch (25 mm) thick.
      f. Polyolefin: 3/4 inch (19 mm), 1 inch (25 mm) thick.
B. Chilled Water and Brine, 40 Deg F (5 Deg C) and below:

1. NPS 3 (DN 80) and Smaller: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe Insulation Wicking System: 2 inches (50 mm) thick.
    c. Phenolic: 2 inches (50 mm)
    d. Polyisocyanurate: 2 inches (50 mm).
2. NPS 4 (DN 100) to NPS 12 (DN 300) : Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe Insulation Wicking System: 2 inches (50 mm) thick.
    c. Phenolic: 2 inches (50 mm)
    d. Polyisocyanurate: 2 inches (50 mm).
3. NPS 14 (DN 350) and Larger: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe Insulation Wicking System: 2 inches (50 mm) thick.
    c. Phenolic: 2 inches (50 mm)

C. Chilled Water and Brine, above 40 Deg F (5 Deg C):
1. NPS 12 (DN 300) and Smaller: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Flexible Elastomeric: 2 inches (50 mm) thick.
    c. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe Insulation Wicking System: 2 inches (50 mm) thick.
    d. Phenolic: 2 inches (50 mm).
    e. Polyisocyanurate: 2 inches (50 mm).
    f. Polyolefin: 2 inches (50 mm).
2. NPS 14 (DN 350) and Larger: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm)
    b. Mineral-Fiber Preformed Pipe, Type I, , Pipe and Tank Insulation, , or, Pipe Insulation Wicking System: 2 inches (50 mm)
    c. Phenolic: 2 inches (50 mm)

D. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:
1. NPS 12 (DN 300) and Smaller: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe, Type I: 2 inches (50 mm) thick.
    c. Phenolic: 2 inches (50 mm).
    d. Polyisocyanurate: 2 inches (50 mm).
2. NPS 14 (DN 350) and Larger: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm),.
    b. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe and Tank Insulation: 2 inches (50 mm).
    c. Phenolic: 2 inches (50 mm).

E. Dual Temperature-Water Supply and Return, 40Deg F (5 Deg C) to 200 Deg F (93 Deg C) and Below:
1. NPS 12 (DN 300) and Smaller: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe, Type I: 2 inches (50 mm) thick.
    c. Phenolic: 2 inches (50 mm).
    d. Polyisocyanurate: 2 inches (50 mm).
2. NPS 14 (DN 350) and Larger: Insulation shall be one of the following:
    a. Cellular Glass: 2 inches (50 mm),.
    b. Mineral-Fiber, Preformed Pipe, Type I, or, Pipe and Tank Insulation: 2 inches (50 mm).
    c. Phenolic: 2 inches (50 mm).

d.

F. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
d. Phenolic: 1 inch (25 mm) thick.
e. Polyisocyanurate: 1 inch (25 mm) thick.
f. Polyolefin: 1 inch (25 mm) thick.

G. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Polyolefin: 1 inch (25 mm) thick.

**3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

A. Chilled Water and Brine:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 3 inches (75 mm) thick.
b. Flexible Elastomeric: 3 inches (75 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches (75 mm) thick.
d. Phenolic: 2 inches (50 mm) thick.
e. Polyisocyanurate: 2 inches (50 mm) thick.
f. Polyolefin: 3 inches (75 mm) thick.
g. Polystyrene: 2 inches (50 mm) thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 3 inches (75 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
c. Phenolic: 2 inches (50 mm) thick.
d. Polyisocyanurate: 2 inches (50 mm) thick.

C. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 2 inches (50 mm) thick.
b. Flexible Elastomeric: 2 inches (50 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
d. Phenolic: 2 inches (50 mm) thick.
e. Polyisocyanurate: 2 inches (50 mm) thick.
f. Polyolefin: 2 inches (50 mm) thick.
g. Polystyrene: 2 inches (50 mm) thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 2 inches (50 mm) thick.
b. Polyolefin: 2 inches (50 mm) thick.

**3.20 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE**

A. Chilled Water, All Sizes: Cellular glass, 2 inches (50 mm) thick.

B. Heating-Hot-Water Supply and Return, All Sizes, 200 Deg F (93 Deg C) and Below:
1. Cellular glass, 3 inches (75 mm) thick.

C. Dual Temperature-Water Supply and Return, All Sizes, 200 Deg F (93 Deg C) and Below:
1. Cellular glass, 3 inches (75 mm) thick.

**3.21 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. Piping, Concealed:
1. None.

D. Piping, Exposed:
   1. None.

**3.22 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. Piping, Concealed:
   1. PVC, PVC, Color-Coded by System: 20 mils (0.5 mm), 30 mils (0.8 mm) thick.
   2. Aluminum, Smooth, Corrugated, Stucco Embossed: 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm) thick.
   3. Painted Aluminum, Smooth, Corrugated, Stucco Embossed: 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm) thick.
   4. Stainless Steel, Type 304, 316, 304 or 316, Smooth 2B Finish, Corrugated, Stucco Embossed: 0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm) thick.
D. Piping, Exposed:
   1. PVC: 20 mils (0.5 mm), 30 mils (0.8 mm), 40 mils (1.0 mm) thick.
   2. Painted Aluminum, Smooth, Corrugated, Stucco Embossed, with Z-Shaped Locking Seam: 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm) thick.
   3. Stainless Steel, Type 304, 316, 304 or 316, Smooth 2B Finish, Corrugated, Stucco Embossed, with Z-Shaped Locking Seam: 0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm) thick.

**3.23 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET**

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**3.24 LAGGING INSTALLATION**

A. Apply lagging with adequate clearance as to provide free movement of vibration isolation equipment. Insulation shall not cause misalignment or rigidly bypass vibration isolation equipment connected to the piping/ductwork.
B. Pipe/duct lagging shall be provided on the following pipe/duct sections:
   1. In locations noted on the contract drawings.
   2. Piping/ductwork, within an Acoustically Sensitive Room (ASR), with an airflow rate greater than 800 feet per minute (4 m/s) or piping with a flow rate of greater than 4 feet per second (1.2 m/s), which is not enclosed within gypsum board, plaster, or concrete construction.
C. Where duct lagging material meets a wall, slab, or ceiling, the lagging material shall be overlapped onto the wall, slab, or ceiling. Any cracks or openings shall be sealed to form an airtight closure.
D. Pipe lagging material shall be overlapped in each direction, and the seams and edges sealed to form an airtight closure.

**END OF SECTION**

## SECTION 23 09 00

## INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1- GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Section 230519 "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

### 1.03 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

### 1.04 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Mobile phone graphics built into programming so that complete access to system from smart phone and tablet is possible.
4. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
5. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
6. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
7. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
8. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
9. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).

b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).

c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).

d. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).

e. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).

f. Relative Humidity: Plus or minus 5 percent.

g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.

h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.

i. Airflow (Terminal): Plus or minus 10 percent of full scale.

j. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).

k. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).

l. Carbon Monoxide: Plus or minus 5 percent of reading.

m. Carbon Dioxide: Plus or minus 50 ppm.

n. Electrical: Plus or minus 5 percent of reading.

**1.05 ACTION SUBMITTALS**

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.

2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.

3. Wiring Diagrams: Power, signal, and control wiring.

4. Details of control panel faces, including controls, instruments, and labeling.

5. Written description of sequence of operation.

6. Schedule of dampers including size, leakage, and flow characteristics.

7. Schedule of valves including flow characteristics.

8. DDC System Hardware:

a. Wiring diagrams for control units with termination numbers.

b. Schematic diagrams and floor plans for field sensors and control hardware.

c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.

b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.

c. Written description of sequence of operation including schematic diagram.

d. Points list.

C. Samples for Initial Selection: For each color required, of each type of thermostat/sensor cover with factory-applied color finishes.

D. Samples for Verification: For each color required, of each type of thermostat/sensor cover.

**1.06 INFORMATIONAL SUBMITTALS**

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

B. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.

C. Qualification Data: For Installer.

D. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

E. Field quality-control test reports.

**1.07 CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.

2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.

4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

5. Software license required by and installed for DDC workstations and control systems.

## 1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique thermostat

2. Maintenance Materials: One thermostat adjusting key(s).

## 1.09 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

## 1.10 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

## 1.11 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Section 281600 "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.

C. Coordinate equipment with Section 281300 "Access Control" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with Section 275313 "Clock Systems" to achieve compatibility with equipment that interfaces with that system.

E. Coordinate equipment with Section 284619 "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.

F. Coordinate equipment with Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

G. Coordinate equipment with Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.

H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

I. Coordinate equipment with Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

J. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.

K. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

## PART 2- PRODUCTS

### 2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.02 CONTROL SYSTEM

A. Manufacturers:

1. Johnson Controls, Inc.; Controls Group.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

D. Control system shall include the following:

1. Building intrusion detection system specified in Section 281600 "Intrusion Detection."

2. Building clock control system specified in Section 275313 "Clock Systems."

3. Building lighting control system specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

4. Fire alarm system specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

### 2.03 DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.

b. Discrete/digital, analog, and pulse I/O.

c. Monitoring, controlling, or addressing data points.

d. Software applications, scheduling, and alarm processing.

e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with

differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.

b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.

c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.

d. Remote communications.

e. Maintenance management.

f. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.

b. Discrete/digital, analog, and pulse I/O.

c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.

2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.

3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.

2. Maximum response time of 10 nanoseconds.

3. Minimum transverse-mode noise attenuation of 65 dB.

4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.04 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
5. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
6. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

## 2.05 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## 2.06 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig (21 to 90 kPa).
2. Proportional band shall extend from 2 to 20 percent for 5 psig (35 kPa).
3. Authority shall be 20 to 200 percent.
4. Air-supply pressure of 18 psig (124 kPa), input signal of 3 to 15 psig (21 to 103 kPa), and output signal of zero to supply pressure.
5. Gages: 1-1/2 inches (38 mm), 2-1/2 inches (64 mm), 3-1/2 inches (89 mm) in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

## 2.07 TIME CLOCKS

A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

## 2.08 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. Ebtron, Inc.
   c. Heat-Timer Corporation.
   d. I.T.M. Instruments Inc.
   e. MAMAC Systems, Inc.
   f. RDF Corporation.
2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C), 0.36 deg F (0.2 deg C) at calibration point.
3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, 8 inches (200 mm), 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible, 72 inches (1830 mm) long, flexible, 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:
1. Manufacturers:
   a. BEC Controls Corporation.
   b. MAMAC Systems, Inc.
   c. RDF Corporation.
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 48 inches (1200 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.
1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.
2. Accuracy: 5 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.

6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C), minus 22 to plus 185 deg F (minus 30 to plus 85 deg C), minus 40 to plus 170 deg F (minus 40 to plus 76 deg C).

7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.

b. General Eastern Instruments.

c. MAMAC Systems, Inc.

d. ROTRONIC Instrument Corp.

e. TCS/Basys Controls.

f. Vaisala.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.

b. Output: 4 to 20 mA.

c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).

d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.

4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.

5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.

2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base

3. Adjusting Key: As required for calibration and cover screws.

**2.09 STATUS SENSORS**

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

**2.10** GAS DETECTION EQUIPMENT

A. Manufacturers:

1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.
5. Greystone Energy Systems Inc.
6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. Toxalert
14. TSI Incorporated.
15. Vaisala.
16. Vulcain Inc.

B. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at [50 and 100] [35 and 200] ppm.

C. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

D. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F (0 to 593 deg C) and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

E. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

**2.11 FLOW MEASURING STATIONS**

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

1. Manufacturers:s
    a. Air Monitor Corporation.

b. Wetmaster Co., Ltd.

c. Ebtron

2. Casing: Galvanized-steel frame.

3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.

4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

## 2.12 THERMOSTATS

A. Manufacturers:

1. Erie Controls.

2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.

3. Heat-Timer Corporation.

4. Sauter Controls Corporation.

5. tekmar Control Systems, Inc.

6. Theben AG - Lumilite Control Technology, Inc.

7. *Installed manufacturer of DOAS, RTU, VRF, baseboards, and cabinet heaters can be used, as long as they’re ordered with ports for GBMS tie in.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.

2. Preferential rate control to minimize overshoot and deviation from set point.

3. Set up for four separate temperatures per day.

4. Instant override of set point for continuous or timed period from 1 hour to 31 days.

5. Short-cycle protection.

6. Programming based on every day of week.

7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.

8. Battery replacement without program loss.

9. Thermostat display features include the following:

a. Time of day.

b. Actual room temperature.

c. Programmed temperature.

d. Programmed time.

e. Duration of timed override.

f. Day of week.

g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

H. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

**2.13** HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Pneumatic Room Humidistats: Wall-mounting, proportioning type with adjustable throttling range, 20 to 90 percent operating range, and cover matching room thermostat cover.

C. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

D. Pneumatic Duct-Mounting Humidistats: Proportioning type with adjustable throttling range, 20 to 90 percent operating range, in galvanized-steel duct box.

**2.14** ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:
   a. Belimo Aircontrols (USA), Inc.
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
   e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

7. Power Requirements (Two-Position Spring Return): 24 -V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 12 seconds open, 5 seconds closed.

C. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required and start-point adjustment and positioning relay. Operator shall maintain full shutoff at maximum pump differential pressure.

D. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Where actuators operate in sequence, provide pilot positioners.

1. Pilot Positioners: With the following characteristics:
   a. Start Point: Adjustable from 2 to 12 psig (14 to 83 kPa).
   b. Operating Span: Adjustable from 5 to 13 psig (35 to 90 kPa).
   c. Linearity: Plus or minus 10 percent of output signal span.
   d. Hysteresis: 3 percent of span.
   e. Response: 0.25-psig (1723-Pa) input change.
   f. Maximum Pilot Signal Pressure: 20 psig (140 kPa).
   g. Maximum Control Air-Supply Pressure: 60 psig (410 kPa).
2. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 deg F (10 to 60 deg C) unless located in return-air plenums.
3. Inlet-Vane Operators: High pressure, with pilot positioners.

**2.15** DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. Pottorff
4. TAMCO (T. A. Morrison & Co. Inc.).
5. United Enertech Corp.
6. Vent Products Company, Inc.

B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

**2.16** AIR SUPPLY

A. Manufacturers:

1. Drainview Products.

2. Pneuline Controls.

B. Control and Instrumentation Tubing: Copper tubing complying with ASTM B 88, Type K (ASTM B 88M, Type A) or ASTM B 280 Type ACR.

1. Fittings: Cast-bronze solder fittings complying with ASME B16.18; or wrought-copper solder fittings complying with ASME B16.22, except forged-brass compression-type fittings at connections to equipment.

2. Joining Method: Soldered or brazed.

C. Control and Instrumentation Tubing: ASTM D 2737 Type FR plenum-rated polyethylene, flame-retardant, nonmetallic tubing rated for 30 psig (207 kPa) and ambient temperature range of 10 to 150 deg F (minus 13 to plus 65 deg C) with flame-retardant harness for multiple tubing.

1. Fittings: Compression or push-on polyethylene fittings.

D. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.

E. Duplex Air Compressor: Capacity to supply compressed air to temperature-control system.

1. Pressure control with adjustable electric contacts, set to start and stop both compressors at different pressures.

2. Electrical alternation set with motor starters and disconnect to operate compressors alternately or on time schedule.

F. Simplex Air Compressor: Tank-mounting compressor with capacity to supply compressed air to temperature-control system, with starter and disconnect.

1. Pressure control with adjustable electric contacts, set to start and stop compressor.

G. Size compressor and tank to operate compressor not more than **30** minutes during a 60-minute period.

H. Compressor Accessories: Low-resistance intake-air filter, and belt guards.

I. System Accessories: Air filter rated for 97 percent efficiency at rated airflow, and combination filter/pressure-reducing station or separate filter and pressure-reducing station.

J. Refrigerated Air Dryer: Self-contained, refrigerated air dryer complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve.

1. Heat Exchangers: Air-to-refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.

2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F (minus 11 deg C) at 20 psig (140 kPa), housed in steel cabinet with access door and panel.

3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, on-off switch, high-temperature light, power-on light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, and with contacts for remote indication of power status and high-temperature alarm.

K. Desiccant Dryer: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F (minus 9 deg C) below inlet-air dew point at design conditions.

L. Pressure Gages: Black letters on white background, 2-1/2 inches (64 mm) in diameter, flush or surface mounting, with front calibration screw to match sensor, and having a graduated scale in psig (kPa).

M. Instrument Pressure Gages: Black letters on white background, 1-1/2 inches (38 mm) in diameter, stem mounted, with suitable dial range.

N. Diaphragm Control and Instrument Valves: 1/4-inch (6-mm) forged-brass body with reinforced polytetrafluoroethylene diaphragm, stainless-steel spring, and color-coded phenolic handle.

O. Gage Cocks: Tee or level handle, bronze, rated for 125 psig (860 kPa).

P. Relays: For summing, reversing, and amplifying highest or lowest pressure selection; with adjustable I/O ratio.

Q. Switches: With indicating plates and accessible adjustment; calibrated and marked.

R. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve.

S. Particle Filters: Zinc or aluminum castings with 97 percent filtration efficiency at rated airflow, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.

T. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.

U. Airborne Oil Filter: Filtration efficiency of 99.9 percent for airborne lubricating oil particles of 0.025 micron or larger.

V. Pressure Relief Valves: ASME rated and labeled.

1. High Pressure: Size for installed capacity.

2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.

W. Pressure-Reducing Stations: Two parallel pressure regulators.

## 2.17 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

# PART 3- EXECUTION

## 3.01 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct-mounted, and equipment-mounted devices are installed before proceeding with installation.

## 3.02 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Mount compressor and tank unit on elastomeric mounts, spring isolators with 1-inch (25 mm) static deflection, restrained spring isolators with 1-inch (25-mm) static deflection. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC.",

Section 230548.13 "Vibration Controls for HVAC." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.

D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm), 60 inches (1530 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Section 233300 "Air Duct Accessories."

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

I. Install hydronic instrument wells, valves, and other accessories according to Section 232116 Hydronic Piping Specialties."

J. Install steam and condensate instrument wells, valves, and other accessories according toSection 232216 Steam and Condensate Piping Specialties."

K. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."

L. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

M. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

**3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

**3.04 FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

4. Pressure test control air piping at 30 psig (207 kPa) or 1.5 times the operating pressure for 24 hours, with maximum 5-psig (35-kPa) loss.

5. Pressure test high-pressure control air piping at 150 psig (1034 kPa) and low-pressure control air piping at 30 psig (207 kPa) for 2 hours, with maximum 1-psig (7-kPa) loss.

6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

7. Test each point through its full operating range to verify that safety and operating control set points are as required.

8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

9. Test each system for compliance with sequence of operation.

10. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check instrument tubing for proper fittings, slope, material, and support.

5. Check installation of air supply for each instrument.

6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.

7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

8. Check temperature instruments and material and length of sensing elements.

9. Check control valves. Verify that they are in correct direction.

10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.

11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.

    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.

    c. Verify that spare I/O capacity has been provided.

    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

**3.05 ADJUSTING**

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.

    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.

    c. Check digital inputs using jumper wire.

    d. Check digital outputs using ohmmeter to test for contact making or breaking.

    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.

    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.

    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.

    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.

10. Provide diagnostic and test instruments for calibration and adjustment of system.

11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

**3.06 DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

**END OF SECTION**

## SECTION 23 11 23

## FACILITY NATURAL-GAS PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.

#### 1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

#### 1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa)

#### 1.05 ACTION SUBMITTALS

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

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

**1.06 INFORMATIONAL SUBMITTALS**

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Welding certificates.

**1.07 CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For operation, and maintenance manuals.

**1.08 QUALITY ASSURANCE**

A. Steel Support 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.

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.

**1.09 DELIVERY, STORAGE, AND HANDLING**

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

**PART 2 PRODUCTS**

**2.01 PIPES, TUBES, AND FITTINGS**

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.

c. Lapped Face: Not permitted underground.

d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

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. OmegaFlex, Inc.

b. Parker Hannifin Corporation; Parflex Division.

c. Titeflex.

d. Tru-Flex Metal Hose Corp.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.

3. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.

2) Smoke-Developed Index: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.

5. Striker Plates: Steel, designed to protect tubing from penetrations.

6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

7. Operating-Pressure Rating: 5 psig (34.5 kPa).

C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.

1. Aluminum Alloy: Alloy 5456 is prohibited.

2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.

3. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper-alloy fittings.

b. Metal-to-metal compression seal without gasket.

c. Dryseal threads shall comply with ASME B1.20.3.

D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K or ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
   a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.

E. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K or ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
   a. Copper fittings with long nuts.
   b. Metal-to-metal compression seal without gasket.
   c. Dryseal threads complying with ASME B1.20.3.
3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.

## 2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm.)

## 2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.04 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
   6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
   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. BrassCraft Manufacturing Company; a Masco company.
      b. Conbraco Industries, Inc.; Apollo Div.
      c. Lyall, R. W. & Company, Inc.
      d. McDonald, A. Y. Mfg. Co.
      e. Perfection Corporation; a subsidiary of American Meter Company.
   2. Body: Bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated brass.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Separate packnut with adjustable-stem packing threaded ends.
   7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   8. CWP Rating: 600 psig (4140 kPa).

9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
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. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
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. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.
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. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
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. McDonald, A. Y. Mfg. Co.
   b. Mueller Co.; Gas Products Div.
   c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).

9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

**2.05 PRESSURE REGULATORS**

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
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. Actaris.
b. American Meter Company.
c. Eclipse Combustion, Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div.
    c. Harper Wyman Co.
    d. Maxitrol Company.
    e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 1 psig

**2.06 DIELECTRIC FITTINGS**

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. Jomar International Ltd.
    e. Matco-Norca, Inc.
    f. McDonald, A. Y. Mfg. Co.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    h. Wilkins; a Zurn company.
2. Description:
    a. Standard: ASSE 1079.
    b. Pressure Rating: 125 psig minimum at 180 deg F
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

## 2.07 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

## 3.02 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

## 3.03 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

## 3.04 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    a. Exception: Tubing passing through partitions or walls does not require striker barriers.
3. Prohibited Locations:
    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install sleeves for piping penetrations of walls, ceilings, and floors.

W. Install sleeve seals for piping penetrations of concrete walls and slabs.

X. Install escutcheons for piping penetrations of walls, ceilings, and floors.

**3.05 SERVICE-METER ASSEMBLY INSTALLATION**

A. Install service-meter assemblies aboveground.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

**3.06 VALVE INSTALLATION**

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

**3.07 PIPING JOINT CONSTRUCTION**

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

**3.08 HANGER AND SUPPORT INSTALLATION**

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

C. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
   4. NPS 1 (DN 25): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

**3.09 CONNECTIONS**

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

**3.10 LABELING AND IDENTIFYING**

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

**3.11 PAINTING**

A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

## 3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to [NFPA 54] [the International Fuel Gas Code] and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
2. Annealed temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Annealed temper copper tube with wrought-copper fittings and brazed joints.

## 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
3. Aluminum tube with flared fittings and joints.
4. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

**3.15** INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be[ **one of**] the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
3. Annealed-temper, copper tube with wrought-copper fittings and [**brazed**] [**flared**] joints.
4. Aluminum tube with flared fittings and joints.
5. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be **one of** the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, piping shall be **one of** the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

**3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.

2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

**END OF SECTION**

**SECTION 23 21 13**

**HYDRONIC 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 pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Blowdown-drain piping.
6. Air-vent piping.
7. Safety-valve-inlet and -outlet piping.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
1. RTRP and RTRF with adhesive.
2. Pressure-seal fittings.
3. Chemical treatment.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

# PART 2 - PRODUCTS

## 2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B), ASTM B 88, Type M (ASTM B 88M, Type C).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Anvil International, Inc.

b. Star Pipe Products.
c. Victaulic Company.

3. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
4. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.

E. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. NIBCO INC.
b. Viega.

3. Housing: Copper.
4. O-Rings and Pipe Stops: EPDM.
5. Tools: Manufacturer's special tools.
6. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).

F. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. T-DRILL Industries Inc.

G. Wrought-Copper Unions: ASME B16.22.

## 2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Anvil International, Inc.
    b. Central Sprinkler Company.
    c. Star Pipe Products.
    d. Victaulic Company.

3. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
4. Couplings: Ductile- or malleable-iron housing and EPDM, or, nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Victaulic Company.

3. Housing: Steel.
4. O-Rings and Pipe Stop: EPDM.
5. Tools: Manufacturer's special tool.
6. Minimum 300-psig (2070-kPa) working-pressure rating at 230 deg F (110 deg C).

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

## 2.3 FIBERGLASS PIPE AND FITTINGS

A. RTRP: ASTM D 2996, filament-wound pipe with tapered bell and spigot ends for adhesive joints.

B. RTRF: Compression or spray-up/contact molded of same material, pressure class, and joining method as pipe.

C. Flanges: ASTM D 4024. Full-face gaskets suitable for the service, minimum 1/8-inch (3.2-mm) thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.

## 2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

1. Fiberglass adhesive shall have a VOC content of 80 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBI (King Bros. Industries).

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBI (King Bros. Industries).
d. NIBCO INC; Model #T/S-1710.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

## 2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. Hart Industries International, Inc.
e. Jomar International, Ltd.
f. Matco-Norca.
g. Watts Regulator Co.
h. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C), 150 psig (1035 kPa), 250 psig (1725 kPa) .
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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

products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts Regulator Co.
e. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C), 150 psig (1035 kPa), 175 psig (1200 kPa), 300 psig (2070 kPa) .
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
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 (1035 kPa) .
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elster Perfection.
b. Grinnell Mechanical Products.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Description:

a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F 1545.

c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C) .
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller , shall be any of the following:

1. Type L (Type B), Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, pressure-seal joints.
2. Schedule 40, Schedule 30, Schedule 20, Grade B, Type 96 steel pipe; Class 125, cast-iron, Class 150, malleable-iron, Class 250, cast-iron, Class 300, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
4. Schedule 40, Schedule 80 pipe and fittings and solvent-welded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger , shall be any of the following:

1. Type L (Type B), Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed joints.
2. Schedule 40, Schedule 30, Schedule 20 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40, Schedule 30, Schedule 20 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Schedule 40, Schedule 80 pipe and fittings and solvent-welded joints.
5. RTRP and RTRF with adhesive or flanged joints.

C. Hot-water heating piping installed belowground and within slabs shall be either of the following:

1. Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered, brazed joints. Use the fewest possible joints.
2. RTRP and RTRF with adhesive or flanged joints.

D. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller , shall be any of the following:

1. Type L (Type B), Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, pressure-seal joints.
2. Schedule 40, Schedule 30, Schedule 20 steel pipe; Class 125, cast-iron, Class 150, malleable-iron, Class 250, cast-iron, Class 300, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
4. Schedule 40, Schedule 80 pipe and fittings and solvent-welded joints.

E. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger , shall be any of the following:

1. Type L (Type B), Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed joints.

2. Schedule 40, Schedule 30, Schedule 20 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40, Schedule 30, Schedule 20 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Schedule 40, Schedule 80
5. pipe and fittings and solvent-welded joints.
6. RTRP and RTRF with adhesive or flanged joints.

F. Chilled-water piping installed belowground and within slabs shall be either of the following:

1. Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered, brazed joints. Use the fewest possible joints.
2. RTRP and RTRF with adhesive or flanged joints.

G. Makeup-water piping installed aboveground shall be either of the following:

1. Type L (Type B), Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed joints.
2. Schedule 40, Schedule 80 pipe and fittings, and solvent-welded joints.

H. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

I. Condensate-Drain Piping: Type M (Type C), Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

J. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

K. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

L. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.

M. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

## 3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

## 3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples, unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) : Use dielectric flanges, flange kits, nipples.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

## 3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 (DN 32:)Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

H. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

## 3.5 PIPE 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 pipe and fittings before assembly.

C. 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.

D. 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/A5.8M.

E. 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.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

## 3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

## 3.7 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5 .
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate: 1000 to 1500 ppm.
    b. Molybdate: 200 to 300 ppm.
    c. Chromate: 200 to 300 ppm.
    d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
    e. Chromate Plus Molybdate: 50 to 100 ppm each.

6. Soluble Copper: Maximum of 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
8. Total Suspended Solids: Maximum of 10 ppm.
9. Ammonia: Maximum of 20 ppm.
10. Free Caustic Alkalinity: Maximum of 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
    c. Nitrate Reducers: 100 organisms/mL.
    d. Sulfate Reducers: Maximum of zero organisms/mL.
    e. Iron Bacteria: Maximum of zero organisms/mL.

B. Install bypass chemical feeders in each hydronic system where indicated.

1. Install in upright position with top of funnel not more than 48 inches (1200 mm) above the floor.
2. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
3. Install NPS 3/4 (DN 20) pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Fill systems that have antifreeze or glycol solutions with the following concentrations:

1. Hot-Water Heating Piping: No glycol.
2. Chilled-Water Piping: Minimum of 15 percent propylene glycol.

## 3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

**END OF SECTION**

## SECTION 23 21 16

## HYDRONIC 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. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Blowdown-drain piping.
6. Air-vent piping.
7. Safety-valve-inlet and -outlet piping.

### 1.3 ACTION SUBMITTALS

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

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

### 1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

## PART 2 - PRODUCTS

### 2.1 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."Section 15112 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."Section 15900 "HVAC Instrumentation and Controls."

C. Plastic Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Valve, Inc.
    b. Asahi/America.
    c. Charlotte Pipe and Foundry Company.
    d. Colonial Engineering.
    e. George Fischer Inc.
    f. Hayward Industrial Products, Inc.
    g. IPEX Inc.
    h. Jomar International, Ltd.
    i. KBI (King Bros. Industries).
    j. Legend Valve.
    k. NIBCO INC.
    l. Plast-O-Matic Valves, Inc.
    m. SMC The Specialty Mfg. Co.
    n. Thermoplastic Valves Inc.
    o. Watts Regulator Co.

3. Body: One-, two-, or three-piece CPVC or PVC to match piping.
4. Ball: Full-port CPVC or PVC to match piping.
5. Seats: PTFE.
6. Seals: EPDM.
7. End Connections: Socket, union, or flanged.
8. Handle Style: Tee shape.
9. CWP Rating: Equal to piping service.
10. Maximum Operating Temperature: Equal to piping service.
11. Comply with MSS SP-122.

D. Plastic Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Valve, Inc.
    b. Asahi/America.
    c. Colonial Engineering.
    d. George Fischer Inc.
    e. Hayward Industrial Products, Inc.
    f. IPEX Inc.
    g. Legend Valve.
    h. NIBCO INC.
    i. Plast-O-Matic Valves, Inc.
    j. SMC The Specialty Mfg. Co.
    k. Thermoplastic Valves Inc.
    l. Watts Regulator Co.

3. Body: PVC or CPVC to match piping wafer type for installation between flanges.
4. Disc: EPDM-coated steel.
5. Seats: PTFE.
6. Handle Style: Locking lever.
7. CWP Rating: Equal to piping service.
8. Maximum Operating Temperature: Equal to piping service.

E. Plastic Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Valve, Inc.
    b. Asahi/America.
    c. Colonial Engineering.
    d. George Fischer Inc.
    e. Hayward Industrial Products, Inc.
    f. IPEX Inc.
    g. KBI (King Bros. Industries).
    h. Legend Valve.
    i. NIBCO INC.
    j. Plast-O-Matic Valves, Inc.
    k. SMC The Specialty Mfg. Co.
    l. Thermoplastic Valves Inc.
    m. Watts Regulator Co.

3. Body: One-, two-, or three-piece PVC or CPVC to match piping.
4. Ends: Socket or flanged.
5. Seats: PTFE.
6. Check Style: Swing or ball type.
7. CWP Rating: Equal to piping service.
8. Maximum Operating Temperature: Equal to piping service.

F. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump.
    c. Griswold Controls.

3. Body: Bronze, ball or plug type with calibrated orifice or venturi.
4. Ball: Brass or stainless steel.
5. Plug: Resin.
6. Seat: PTFE.
7. End Connections: Threaded or socket.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig (860 kPa).
11. Maximum Operating Temperature: 250 deg F (121 deg C).

G. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump.
    c. Griswold Controls.

3. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
4. Ball: Brass or stainless steel.
5. Stem Seals: EPDM O-rings.
6. Disc: Glass and carbon-filled PTFE.
7. Seat: PTFE.
8. End Connections: Flanged or grooved.
9. Pressure Gage Connections: Integral seals for portable differential pressure meter.
10. Handle Style: Lever, with memory stop to retain set position.
11. CWP Rating: Minimum 125 psig (860 kPa).
12. Maximum Operating Temperature: 250 deg F (121 deg C).

H. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Conbraco Industries, Inc.
e. Watts Regulator Co.

3. Body: Bronze or brass.
4. Disc: Glass and carbon-filled PTFE.
5. Seat: Brass.
6. Stem Seals: EPDM O-rings.
7. Diaphragm: EPT.
8. Low inlet-pressure check valve.
9. Inlet Strainer: removable without system shutdown.
10. Valve Seat and Stem: Noncorrosive.
11. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

I. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump.
c. Conbraco Industries, Inc.
d. Watts Regulator Co.

3. Body: Bronze or brass.
4. Disc: Glass and carbon-filled PTFE.
5. Seat: Brass.
6. Stem Seals: EPDM O-rings.
7. Diaphragm: EPT.
8. Wetted, Internal Work Parts: Brass and rubber.
9. Inlet Strainer: , removable without system shutdown.
10. Valve Seat and Stem: Noncorrosive.
11. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

J. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Flow Design Inc.
b. Griswold Controls.
c. Nexus Valve, Inc.

3. Body: Brass or ferrous metal.
4. Piston and Spring Assembly: Stainless steel, Corrosion resistant, tamper proof, self-cleaning, and removable.
5. Combination Assemblies: Include bronze or brass-alloy ball valve.
6. Identification Tag: Marked with zone identification, valve number, and flow rate.
7. Size: Same as pipe in which installed.
8. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
9. Minimum CWP Rating: 175 psig (1207 kPa), 300 psig (2070 kPa).
10. Maximum Operating Temperature: 200 deg F (93 deg C), 250 deg F (121 deg C).

## 2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Nexus Valve, Inc.
    e. Taco, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Nexus Valve, Inc.
    e. Taco, Inc.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

C. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Taco, Inc.

2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

D. Diaphragm, Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Taco, Inc.

2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Diaphragm, Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.

b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Taco, Inc.

2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

F. In-Line Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AMTROL, Inc.
b. Armstrong Products, Inc.
c. Bell & Gossett Domestic Pump.
d. Taco, Inc.

2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
3. Maximum Working Pressure: Up to 175 psig (1207 kPa).
4. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

G. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Taco, Inc.

2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Maximum Working Pressure: 150 psig (1035 kPa).
4. Maximum Operating Temperature: 250 deg F (121 deg C).

## 2.3 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: Stainless-steel, 20, 40, 60-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40, 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40, 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping."Section 15124 "Expansion Fittings and Loops for HVAC Piping."

## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install throttling-duty, calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

## 3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

**END OF SECTION**

## SECTION 23 31 13

## METAL DUCTS

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.

### 1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports[ and seismic restraints] shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### 1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
4. Factory- and shop-fabricated ducts and fittings.
5. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
6. Elevation of top of ducts.
7. Dimensions of main duct runs from building grid lines.
8. Fittings.
9. Reinforcement and spacing.
10. Seam and joint construction.
11. Penetrations through fire-rated and other partitions.
12. Equipment installation based on equipment being used on Project.

13. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

14. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

B. Delegated-Design Submittal:

1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.

4. Materials, fabrication, assembly, and spacing of hangers and supports.

5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

**1.05 INFORMATIONAL SUBMITTALS**

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

2. Suspended ceiling components.

3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

**1.06 QUALITY ASSURANCE**

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

**PART 2 PRODUCTS**

**2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints,"

for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.02 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

G. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal

Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.03 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.04 DOUBLE-WALL ROUND[ AND FLAT-OVAL] DUCTS AND FITTINGS

A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Transverse Joints in Ducts Larger Than [60 Inches (1524 mm)] in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at75 deg F (24 deg C) mean temperature.

## 2.05 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.06 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1.

a. Maximum Thermal Conductivity:

1) Type I, Flexible: [0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K)] at 75 deg F (24 deg C) mean temperature.

2) Type II, Rigid: [0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K)]at 75 deg F (24 deg C) mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating.

Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.

2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.07 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches (102 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg (2500-Pa) static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.08 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

# PART 3 EXECUTION

## 3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

## 3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

## 3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

## 3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

**3.05 CONNECTIONS**

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

**3.06 PAINTING**

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

**3.07 FIELD QUALITY CONTROL**

A. Perform tests and inspections.

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Test for leaks before applying external insulation.
3. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
4. Give seven days' advance notice for testing.

B. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

**3.08 DUCT CLEANING**

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

**3.09 START UP**

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

**3.010 DUCT SCHEDULE**

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, galvanized sheet steel.

2. Penetration through any concrete members to have a structurally support sleeve and seal. Coordinate with structural drawings.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1-inch wg (250 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg (500 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :

a. Pressure Class: Positive or negative 1-inch wg (250 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:
    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    a. Pressure Class: Negative 1-inch wg (250 Pa).
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Air-Handling Units:
    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Outdoor-Air Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
    a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
    b. Minimum SMACNA Seal Class: A
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Air-Handling Units:
    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    a. Velocity 1000 fpm (5 m/s) or Lower:
        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.
    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

        1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

        2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

        3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

        4) Radius-to Diameter Ratio: 1.5.

    b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.

    c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter:

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.

    b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.

    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.

    c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

**END OF SECTION**

## SECTION 23 33 00

## AIR DUCT ACCESSORIES

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Flange connectors.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.

### 1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    a. Special fittings.
    b. Manual volume damper installations.
    c. Control-damper installations.
    d. Fire-damper, smoke-damper, combination fire- and smoke-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    e. Wiring Diagrams: For power, signal, and control wiring.

## 1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

## 1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 1.06 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

# PART 2 PRODUCTS

## 2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

## 2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180) G90 (Z275).
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Maximum Air Velocity: 1000 fpm (5.1 m/s).

C. Maximum System Pressure: 2-inch wg (0.5 kPa).

D. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

E. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch (150-mm) width, [0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

F. Blade Action: Parallel.

G. Blade Seals: Extruded vinyl, mechanically locked.

H. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch (5 mm).

I. Tie Bars and Brackets: Galvanized steel.

J. Return Spring: Adjustable tension.

K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
    b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel].
8. Screen Type: Bird/ Insect.
9. 90-degree stops.

**2.04 BAROMETRIC RELIEF DAMPERS**

A. Suitable for horizontal or vertical mounting.

B. Maximum Air Velocity: 1000 fpm (5.1 m/s).

C. Maximum System Pressure: 2-inch wg (0.5 kPa).

D. Blades:

1. Multiple, 0.050-inch- (1.2-mm-) thick aluminum sheet.
2. Maximum Width: 6 inches (150 mm).
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

E. Blade Seals: Vinyl.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets:

1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

H. Return Spring: Adjustable tension.

I. Bearings: Stainless steel.

J. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

**2.05 MANUAL VOLUME DAMPERS**

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
    a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

5. Blade Axles: Galvanized steel.
6. Bearings:
    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Aluminum.

**2.06 CONTROL DAMPERS**

A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

B. Frames:
1. Hat shaped.
2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
3. Interlocking, gusseted corners.

C. Blades:
1. Multiple blade with maximum blade width of 6 inches (152 mm).
2. Parallel- and opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch (1.62 mm) thick single skin or 0.0747-inch- (1.9-mm-) thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

E. Bearings:
1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

**2.07 FIRE DAMPERS**

A. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

B. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum velocity.

C. Fire Rating: 1-1/2 and 3 hours.

D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch (3.5 mm) thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

**2.08 SMOKE DAMPERS**

A. General Requirements: Label according to UL 555S by an NRTL.

B. Smoke Detector: Integral, factory wired for single-point connection.

C. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm) thick, galvanized sheet steel.

D. Leakage: Class I

E. Rated pressure and velocity to exceed design airflow conditions.

F. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

G. Damper Motors: Modulating or two-position action.

H. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

7. Electrical Connection: 115 V, single phase, 60 Hz.

I. Accessories:

1. Auxiliary switches for fan control or position indication.
2. Momentary test switch, remote mounted.

**2.09 COMBINATION FIRE AND SMOKE DAMPERS**

A. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

B. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

E. Heat-Responsive Device: Resettable, 165 deg F (74 deg C) rated, fusible links.

F. Heat-Responsive Device:Electric resettable device and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking overlapping, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.

I. Leakage: Class II.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: Modulating or two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:
1. Auxiliary switches for fan control or position indication.
2. Momentary test switch remote mounted.

**2.010 FLANGE CONNECTORS**

A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

**2.011 TURNING VANES**

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

**2.012 REMOTE DAMPER OPERATORS**

A. Description: Cable system designed for remote manual damper adjustment.

B. Tubing: Copper.

C. Cable: Stainless steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Stainless steel.

## 2.013 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inch (25-by-25-mm)butt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
    a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches (460 mm) Square: Continuous and two sash locks.
    c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches with outside and inside handles.
    d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg (800 to 2000 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

## 2.014 DUCT ACCESS PANEL ASSEMBLIES

A. Labeled according to UL 1978 by an NRTL.

B. Panel and Frame: Minimum thickness 0.0428-inch (1.1-mm) stainless steel.

C. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

E. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

**2.015 FLEXIBLE CONNECTORS**

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

**2.016 FLEXIBLE DUCTS**

A. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

C. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).

3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

D. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

E. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

F. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

**2.017 DUCT ACCESSORY HARDWARE**

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install

dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts directly or]with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

P. Install duct test holes where required for testing and balancing purposes.

**3.02 FIELD QUALITY CONTROL**

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION**

## SECTION 23 37 13

## DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Fixed face registers and grilles.

### 1.03 ACTION 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.

### 1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. 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.

### PART 2 PRODUCTS

### 2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: As scheduled.
3. Finish: Coordinate with Architect.
4. Face Size: 24 by 24 inches, 12 by 12 inches.
5. Face Style: Plaque.
6. Mounting: Surface, T-bar.
7. Pattern: Adjustable.
8. Dampers: Radial opposed blade.

9. Accessories:
    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

**2.02 REGISTERS AND GRILLES**

A. Adjustable Bar Register :
    1. Material: As scheduled.
    2. Finish: Coordinate with Architect.
    3. Frame: Coordinate with Architect.
    4. Damper Type: Adjustable opposed blade.

B. Fixed Face Register :
    1. Material: As scheduled.
    2. Finish: Coordinate with Architect.
    3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid.
    4. Core Construction: Removable.
    5. Frame: Coordinate with Architect.
    6. Damper Type: Adjustable opposed blade.

C. Fixed Face Grille :
    1. Material: As scheduled.
    2. Finish: Coordinate with Architect.
    3. Face Arrangement: 1/2-by-1/2-by-1/2-inch.
    4. Core Construction: Removable.
    5. Frame: Coordinate with Architect.

**2.03 SOURCE QUALITY CONTROL**

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Examine areas where diffusers, 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.

**3.02 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. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.03 ADJUSTING**

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

## SECTION 23 74 13

## PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Gas furnace.
   3. Economizer outdoor- and return-air damper section.
   4. Integral, space temperature controls.
   5. Roof curbs.

#### 1.03 DEFINITIONS

A DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. VVT: Variable-air volume and temperature.

#### 1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

#### 1.05 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for selecting vibration isolators for designing vibration isolation bases.
   2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   3. Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

**1.06 INFORMATIONAL SUBMITTALS**.

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which RTUs will be attached.
   2. Roof openings
   3. Roof curbs and flashing.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

**1.07 CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

**1.08 MAINTENANCE MATERIAL SUBMITTALS**

A. Extra materials may not be allowed for publicly funded projects.

B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set of filters for each unit.

**1.09 QUALITY ASSURANCE**

A. ARI Compliance:
   1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

**1.10 WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
   3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
   4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AAON, Inc.
2. Carrier Corporation.
3. Trane; American Standard Companies, Inc.
4. YORK International Corporation.
5. Daikin

### 2.02 CASING

A. UNIT CASING
1. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge. Provide with 3/4" insulation minimum and internal galvanized steel liner.
2. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
3. Cabinet construction shall allow for all service/maintenance from one side of the unit.
4. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.
5. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
6. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.
7. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
8. Provide 115-volt convenience outlet, factory-installed and power, per NEC requirements.
9. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
10. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

B. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### 2.03 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

### 2.04 COILS

A. Supply-Air Refrigerant Coil:

1. Copper-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coil Split: Interlaced.
4. Baked phenolic coating.
5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

**2.05 REFRIGERANT CIRCUIT COMPONENTS**

A. Retain paragraph below if Project includes only one RTU. If Project requires multiple RTUs, delete paragraph and indicate number of circuits for each RTU in a schedule.

B. Number of Refrigerant Circuits: Two.

C. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

D. Refrigeration Specialties:
1. Refrigerant: R-410A, R-454B, R-32.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

**2.06 AIR FILTRATION**

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2, or as specified on the construction documents.

**2.06 GAS FURNACE**

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.
1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented with vertical extension.

E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve with vertical extension.

F. Safety Controls:
1. Gas Control Valve:Modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

**2.07 DAMPERS**

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

**2.08 ELECTRICAL POWER CONNECTION**

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

**2.09 CONTROLS**

A. Retain first paragraph below to specify temperature controls in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC." Delete first paragraph and retain second paragraph and subparagraphs to require controls integral to the RTU to be provided by RTU manufacturer.

B. Controls shall be self-contained, unit mounted, DDC or electronic.

C. Basic Unit Controls:
   1. Control-voltage transformer.
   2. Wall-mounted thermostat or sensor with the following features:
      a. Heat-cool-off switch.
      b. Fan on-auto switch.
      c. Fan-speed switch.
      d. Automatic changeover.
      e. Adjustable deadband.
      f. Exposed set point.
      g. Exposed indication.
      h. Degree F indication.
      i. Unoccupied-period-override push button.
      j. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply-air temperature, operating mode, and status.
   3. Remote Wall -Mounted Annunciator Panel for Each Unit:
      a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
      b. DDC controller or programmable timer and interface with unit controls.
      c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

D. Electronic Controller:
   1. Controller shall have volatile-memory backup.
   2. Safety Control Operation:
      a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
      b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F (54 deg C) enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
      c. Fire Alarm Control Panel Interface: Provide control interface
      d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F (4 deg C).
      e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
4. Unoccupied Period:
   a. Heating Setback: 10 deg F (5.6 deg C).
   b. Cooling Setback: System off.
   c. Override Operation: Two hours.
5. Supply Fan Operation:
   a. Occupied Periods: Run fan continuously.
   b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
   a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain[discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
   b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
   c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.
7. Gas Furnace Operation:
   a. Occupied Periods: Modulate burner to maintain discharge temperature.
   b. Unoccupied Periods: Cycle burner to maintain setback temperature.
8. Economizer Outdoor-Air Damper Operation:
   a. Occupied Periods: Open to 25 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F (15 deg C). Use mixed-air and outdoor-air temperature to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
   c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 2- to 10-V dc.
9. Carbon Dioxide Sensor Operation (as required):
   a. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 1000-ppm] concentration.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

E. Interface Requirements for future HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet or LonWorks compatible interface for future central HVAC control workstation for the following:
   a. Adjusting set points.
   b. Monitoring supply fan start, stop, and operation.
   c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
   d. Monitoring occupied and unoccupied operations.
   e. Monitoring constant motor loads.
   f. Monitoring cooling load.
   g. Monitoring economizer cycles.
   h. Monitoring air-distribution static pressure and ventilation air volume.

## 2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Low-ambient kit using variable-speed condenser fans for operation down to 35 deg F (1.7 deg C).

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

E. Hail guards of galvanized steel, painted to match casing.

**2.11 ROOF CURBS**

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 2 inches (50 mm).
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 12 inches

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

**3.02 INSTALLATION**

A. Equipment Mounting:
   1. Install RTUs on roof curbsRetain paragraph below if curbs are provided by RTU manufacturer.

B. Roof Curb: Install on roof structure, level and secure, according to [NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts."] [ARI Guideline B.] Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified by architect. Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

**3.03 CONNECTIONS**

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

**3.04 FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

**3.05 STARTUP SERVICE**

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to furnace combustion chamber.
   3. Inspect for visible damage to compressor, coils, and fans.
   4. Inspect internal insulation.
   5. Verify that labels are clearly visible.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.
   8. Verify that filters are installed.
   9. Clean condenser coil and inspect for construction debris.
   10. Clean furnace flue and inspect for construction debris.
   11. Connect and purge gas line.
   12. Remove packing from vibration isolators.
   13. Inspect operation of barometric relief dampers.
   14. Verify lubrication on fan and motor bearings.
   15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   16. Adjust fan belts to proper alignment and tension.
   17. Start unit according to manufacturer's written instructions.
      a. Start refrigeration system.
      b. Do not operate below recommended low-ambient temperature.
      c. Complete startup sheets and attach copy with Contractor's startup report.
   18. Inspect and record performance of interlocks and protective devices; verify sequences.
   19. Operate unit for an initial period as recommended or required by manufacturer.

20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

## 3.06 CLEANING AND ADJUSTING

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

D. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

**END OF SECTION**

**SECTION 26 05 00**
**COMMON WORK RESULTS FOR ELECTRICAL**

## PART 1 GENERAL

**1.01** RELATED DOCUMENTS

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

**1.02 SUMMARY**

A. Section Includes:
   1. Electrical equipment coordination and installation.
   2. Common electrical installation requirements.
   3. Cutting and patching for electrical construction.

**1.03 QUALITY ASSURANCE**

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorizes having jurisdiction and marked for intended use.

B. Comply with NFPA 70.

C. Include in the Work, as a part of the Bid Proposal, labor, materials, services, apparatus, drawings (in addition to the Contract Documents) as required to complete the intended work.

D. Work for the Project must be performed in accordance with Federal, State and Local Laws, Ordinances, Codes, Rules and Regulations, pertaining to the Work which are hereby made a part of the Contract Documents by reference, the same as if repeated herein in their entity. Where Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall Work be installed contrary to or below the minimum legal standards.

E. Comply with the City of Moline, IL and other local amendments.

**1.04 COORDINATION**

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment within minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wire ways, and busways will be clear of obstructions and of the working and access apace of other equipment.

B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section “Access Doors and Frames.”

C. Coordinate sleeve selection and application with selection and application of fire stopping specified in Division 7 Section “Fire stopping.”

## PART 2 EXECUTION

**2.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

**2.02 CUTTING AND PATCHING**

A. Refer to Division 2 for general cutting and patching requirements and procedures.

B. 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.

C. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fire stopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

**2.03 FIRE STOPPING**

A. Apply fire stopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Fire stopping materials and installation requirements are specified in Division 7 Section “Fire stopping”.

**2.04 CLEANING AND PROTECTION**

A. On completion of installation, including outlets, fittings and devices, inspect exposed finish. Remove burrs, dirt, paint spots and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

## SECTION 26 05 19

## LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

#### 1.3 DEFINITIONS

A. VFC: Variable frequency controller.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN, Type XHHW-2, and Type SO.

C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC, metal-clad cable, Type MC, and Type SO with ground wire.

D. VFC Cable:

1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Comply with UL requirements for cables in direct burial applications.

E. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

#### 2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

#### 2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; **s**olid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2 or Type XHHW-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

## 3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

## 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

## 3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

## 3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test **service entrance and feeder conductors** for compliance with requirements.
2. Perform each visual and electrical tests:
    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:
        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Themographic survey.
    c. Inspect compression applied connectors for correct cable match and installation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION**

## SECTION 26 05 26

## GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NFPA 70B.
      1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      2) Include recommended testing intervals.

#### 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

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 UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

#### 2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

**2.3 CONNECTORS**

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

**2.4 GROUNDING ELECTRODES**

A. Ground Rods: Copper-clad 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

**PART 3 - EXECUTION**

**3.1 APPLICATIONS**

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

**3.2 GROUNDING AT THE SERVICE**

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

**3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

A. Comply with IEEE C2 grounding requirements.

B. Grounding Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground

rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

## 3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

## 3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

**3.6 FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:
1. Power or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
5. Pad-Mounted Equipment: 5 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

## SECTION 26 05 29

## HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

### 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 the following:
    a. Hangers.
    b. Steel slotted support systems.
    c. Nonmetallic support systems.
    d. Trapeze hangers.
    e. Clamps.
    f. Turnbuckles.
    g. Sockets.
    h. Eye nuts.
    i. Saddles.
    j. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Nonmetallic slotted-channel systems.
4. Equipment supports.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of trapeze hangers.

### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.

e. Access panels.
f. Projectors.

B. Welding certificates.

## 1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Material: Galvanized steel.
2. Channel Width: 1-5/8 inches.
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
7. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Channel Width: 1-5/8 inches.
2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
5. Channel Dimensions: Selected for applicable load criteria.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.

1. Channel Width: 1-5/8 inches.
2. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are 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.

## 2.3 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 Section 055000 "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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

## 3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

## 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

## 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

## SECTION 26 05 33

## RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

### 1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid steel conduit.
C. IMC: Intermediate metal conduit.

### 1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### PART 2 - PRODUCTS

### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. GRC: Comply with ANSI C80.1 and UL 6.
C. ARC: Comply with ANSI C80.5 and UL 6A.
D. IMC: Comply with ANSI C80.6 and UL 1242.
E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.
G. FMC: Comply with UL 1; zinc-coated steel.
H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ENT: Comply with NEMA TC 13 and UL 1653.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. Continuous HDPE: Comply with UL 651B.

G. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

H. RTRC: Comply with UL 1684A and NEMA TC 14.

I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

J. Fittings for LFNC: Comply with UL 514B.

K. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

## 3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

## 3.3 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## 3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

## SECTION 26 05 53
## IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

### 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 electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

### PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

B. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.3 LABELS

A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels for Raceways and Cables Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceways they identify, and that stay in place by gripping action.

C. Self-Adhesive Labels:

1. Preprinted, 3-mil- thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.

    a. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized to fit the cable or raceway diameter, such that the clear shield overlaps the entire printed legend.

2. Polyester or Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

    a. Nominal Size: 3.5-by-5-inch.

3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

## 2.4 BANDS AND TUBES:

A. Snap-Around, Color-Coding Bands for Raceways and Cables: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters of raceways or cables they identify, and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around cables they identify. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

## 2.5 TAPES AND STENCILS:

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil for Raceways Carrying Circuits 600 V or Less: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

C. Write-On Tags:

1. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to raceway, conductor, or cable.

2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. inches, minimum 1/16-inch-.
   b. For signs larger than 20 sq. inches, 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Self-adhesive.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

J. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

K. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

L. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

### 3.3 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply stripes to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl or Snap-around labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:

      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.

   c. Colors for 480/277-V Circuits:

      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray.

   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

I. Conductors To Be Extended in the Future: Attach write-on tags to conductors and list source.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    a. Power-transfer switches.
    b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
1. Comply with NFPA 70E and ANSI Z535.4.

N. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.
1. Labeling Instructions:
    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment To Be Labeled:
    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Enclosed switches.
    h. Enclosed circuit breakers.
    i. Enclosed controllers.
    j. Variable-speed controllers.
    k. Push-button stations.
    l. Contactors.
    m. Remote-controlled switches, dimmer modules, and control devices.
    n. Power-generating units.
    o. Monitoring and control equipment.

**END OF SECTION**

## SECTION 26 24 16
## PANELBOARDS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

### 1.3 DEFINITIONS

A. ATS: Acceptance testing specification.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. HID: High-intensity discharge.
E. MCCB: Molded-case circuit breaker.
F. SPD: Surge protective device.
G. VPR: Voltage protection rating.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

## 1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

## 1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Construction Manager no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's and Construction Manager's written permission.
3. Comply with NFPA 70E.

## 1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS COMMON REQUIREMENTS

A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

1. Approved manufacturers:
    a. Square D
    b. Eaton Electric Inc.
    c. Siemens Energy

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Kitchen Areas: NEMA 250, Type 1
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

G. Incoming Mains:

1. Location: Contractor to coordinate incoming main location for all panelboards.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum or copper.
    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: Ten percent.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or lugs only.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with [interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:
        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
    i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
k. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
o. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

**2.5 IDENTIFICATION**

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Comply with NECA 1.
C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Or Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

## 3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

## 3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6

Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. 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. Panelboards will be considered defective if they do not pass tests and inspections.

## 3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

## 3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 26 27 26
## WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. GFCI receptacles.
3. Toggle switches.
4. Wall-box dimmers.
5. Wall plates.

#### 1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.
C. EMI: Electromagnetic interference.
D. GFCI: Ground-fault circuit interrupter.
E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
F. RFI: Radio-frequency interference.
G. SPD: Surge protective device.
H. UTP: Unshielded twisted pair.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Tamper-resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

## 2.3 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, Tamper-resistant, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

## 2.4 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole
2. Two Pole
3. Three Way
4. Four Way

C. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

## 2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: High-impact thermoplastic thick, satin-finished.
3. Material for the kitchen space: Galvanized steel.
4. Material for Unfinished Spaces: Galvanized steel.
5. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing. (To be approved by Architect)

B. Wall Plate Color: For plastic covers, match device color.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

## 3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

## 3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

## 3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

**END OF SECTION**

## SECTION 26 28 13

## FUSES

### 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. Cartridge fuses rated 600 V ac and less for use in the following:

a. Enclosed switches.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

2. Fuse sizes for elevator feeders and elevator disconnect switches.

### 1.4 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. Fuses: Equal to 3 percent of quantity installed for each size and type, but no fewer than three of each size and type.

### 1.5 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.

2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC.

3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC.

4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC.

5. Type J: 600-V, zero- to 600-A rating, 200 kAIC.

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 2 EXECUTION

### 2.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

### 2.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

**END OF SECTION**

## SECTION 26 28 16
## ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

### 1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Manufacturer's field service report.

### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

### 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

### 1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Architect and Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Architect's and Construction Manager's written permission.
   4. Comply with NFPA 70E.

### 1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminu ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

## 2.2 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Compression type, suitable for number, size, and conductor material.

## 2.3 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

B. 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.

C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and $I^2t$ response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered.

### 2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
C. Install fuses in fusible devices.
D. Comply with NECA 1.

### 3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

## 3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

**END OF SECTION**

## SECTION 26 51 19
## LED INTERIOR LIGHTING

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

### 1.3 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.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

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. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.

1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

## 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

### 1.10 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 year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE REQUIREMENTS - SEE LIGHT FIXTURE SCHEDULE

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 for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
D. Recessed Fixtures: Comply with NEMA LE 4.
E. Bulb shape complying with ANSI C79.1.
F. Lamp base complying with ANSI C81.61.
G. CRI of minimum 80.
H. Rated L70 lamp life of 50,000 hours.
I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
J. Internal driver.
K. Nominal Operating Voltage: 120 V ac.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

L. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized finish.

### 2.2 RECESSED LINEAR

A. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.
B. Integral junction box with conduit fittings.

### 2.3 STRIP LIGHT

A. Minimum 750 lumens. Minimum allowable efficacy of 75 lumens per watt.
B. Integral junction box with conduit fittings.

### 2.4 SUSPENDED, LINEAR

A. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.

### 2.5 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 relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Prismatic acrylic
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.
4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

## 2.6 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.

## 2.7 LUMINAIRE FIXTURE SUPPORT COMPONENTS

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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

## 3.3 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:
    1. Sized and rated for luminaire weight.
    2. Able to maintain luminaire position after cleaning and relamping.
    3. Provide support for luminaire without causing deflection of ceiling or wall.
    4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
E. Flush-Mounted Luminaire Support:
    1. Secured to outlet box.
    2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
    3. Trim ring flush with finished surface.
F. Wall-Mounted Luminaire Support:
    1. Attached to structural members in walls.
    2. Do not attach luminaires directly to gypsum board.
G. Ceiling-Mounted Luminaire Support:
    1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
    2. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
    3. Ceiling mount with hook mount.
H. Suspended Luminaire Support:
    1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
    2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem 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. Ceiling-Grid-Mounted Luminaires:
    1. Secure to any required outlet box.
    2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
    3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

## 3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.5 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.

## 3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

**END OF SECTION**

## SECTION 27 05 28

## PATHWAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

### 1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

### 1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

C. Samples: For wireways and surface pathways and for each color and texture specified, 12 inches long.

### 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: Steel or die cast.

    b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Rigid HDPE: Comply with UL 651A.

D. Continuous HDPE: Comply with UL 651B.

E. RTRC: Comply with UL 1684A and NEMA TC 14.

F. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway, approved for plenum or general-use installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

## 2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type or Screw-cover type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

## 2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.6 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

## 2.7 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.

K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:

a. Material: Plastic.

b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:

    a. Loading dock.

    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

    c. Mechanical rooms.

    d. Gymnasiums

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.
9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 1-inch trade size. Minimum size for optical-fiber cables is 1 inch.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

## 3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to RNC, Type EPC-40-PVC, before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 1-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-1/4-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.

    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

**3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS**

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

**3.4 FIRESTOPPING**

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

**3.5 PROTECTION**

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

## SECTION 27 15 00

## COMMUNICATIONS HORIZONTAL CABLING

### PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 2.01 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Multimode 50/125-micrometer, optical fiber cabling.
3. Multiuser telecommunications outlet assemblies.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

B. Related Requirements:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

### 3.01 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

I. RCDD: Registered Communications Distribution Designer.

J. UTP: Unshielded twisted pair.

### 4.01 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

**5.01 ACTION SUBMITTALS**

A. Product Data: For each type of product.
   1. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics, including the following:
      a. Cross-connects.
      b. Patch panels.
      c. Patch cords.
   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

**6.01 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

**7.01 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

**8.01 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. Patch-Panel Units: One of each type.
   2. Connecting Blocks: One of each type.
   3. Device Plates: One of each type.
   4. Multiuser Telecommunications Outlet Assemblies: One of each type.

**9.01 QUALITY ASSURANCE**

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
   3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

**10.01 DELIVERY, STORAGE, AND HANDLING**

A. Test cables upon receipt at Project site.
   1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
   2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including 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.

**PART 2 - PRODUCTS**

1.01 **MANUFACTURERS**

1. Approved cable manufacturers:
   a. CommScope Inc
   b. Belden Inc
   c. ADC
   d. Berk-Tek
   e. Panduit

**2.01 HORIZONTAL CABLING DESCRIPTION**

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors 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 outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

**3.01 PERFORMANCE REQUIREMENTS**

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 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.

D. Grounding: Comply with J-STD-607-A.

**4.01 BACKBOARDS**

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

**5.01 UTP CABLE**

A. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6A.
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 MPP, CMP, MPR, CMR, MP, or MPG.
b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
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.

**6.01 UTP CABLE HARDWARE**

A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
B. Connecting Blocks: 110-style IDC for Category 6A. 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.
C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.
D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
F. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

**7.01 OPTICAL FIBER CABLE**

A. Description: OM3 Multimode 50/125-micrometer, 12 strand-fiber, nonconductive, tight buffer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-C.3 for performance specifications.
   3. Comply with TIA-492AAAC 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.
    d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
    e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
    f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Overfilled Modal Bandwidth: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
8. Minimum Effective Modal Bandwidth-length Product: 2000 MHz-km at 850 nm.

B. Jacket:
1. Jacket Color: Yellow for mulitmode 9/125-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.

**8.01 OPTICAL FIBER CABLE HARDWARE**

A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

B. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

C. Cable Connecting Hardware:
1. Comply with 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.
2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

**9.01 CONSOLIDATION POINTS**

A. Description: Consolidation points shall comply with requirements for cable connecting hardware.
1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:

a. One for each four-pair UTP cable indicated.

b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: Recessed in ceiling.

4. NRTL listed as complying with UL 50 and UL 1863.

5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

**10.01 TELECOMMUNICATIONS OUTLET/CONNECTORS**

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Two-port-connector assemblies mounted in single or multigang faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."

2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."

3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.

5. Legend: Machine printed, in the field, using adhesive-tape label.

6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

**11.01 GROUNDING**

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

**12.01 IDENTIFICATION PRODUCTS**

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

**13.01 CABLE MANAGEMENT SYSTEM**

A. Description: Computer-based cable management system, with integrated database and graphic capabilities.

B. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

C. Information shall be presented in database view, schematic plans, or technical drawings.

1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.

D. System shall interface with the following testing and recording devices:
   1. Direct upload tests from circuit testing instrument into the personal computer.
   2. Direct download circuit labeling into labeling printer.

**14.01 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**

**1.01 ENTRANCE FACILITIES**

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

**2.01 WIRING METHODS**

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
C. Wiring within Enclosures:
   1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
   2. Install lacing bars and distribution spools.
   3. Install conductors parallel with or at right angles to sides and back of enclosure.

**3.01 INSTALLATION OF CABLES**

A. Comply with NECA 1.
B. General Requirements for Cabling:
   1. Comply with TIA/EIA-568-B.1.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Install 110-style IDC termination hardware unless otherwise indicated.
   4. MUTOA shall not be used as a cross-connect point.

5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. 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.
10. 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.
11. Cold-Weather Installation: Bring cable to room temperature before installation. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
    1. Comply with TIA/EIA-568-B.2.
    2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:
    1. Comply with TIA/EIA-568-B.3.
    2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
    1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
    2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
   1. Install plenum-rated cable only.
   2. Install cabling after the flooring system has been installed in raised floor areas.
   3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA-569-B 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.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
   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.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
   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.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches
   5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
   6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

**4.01 FIRESTOPPING**

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

**5.01 GROUNDING**

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

**6.01 IDENTIFICATION**

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 1.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches 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 device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. 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 being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.
5. 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.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
    1. Cables use flexible vinyl or polyester that flex as cables are bent.

**7.01 FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
    1. Visually inspect UTP and optical fiber cable 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/EIA-568-B.1.
    2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
    3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper 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.
5. 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) Horizontal and multimode backbone 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 backbone 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.
6. UTP Performance Tests:
    a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

**8.01 SOFTWARE SERVICE AGREEMENT**

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

**9.01 DEMONSTRATION**

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

**END OF SECTION**

## SECTION 32 18 13
## SYNTHETIC GRASS SURFACING

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Synthetic grass surfacing and infill.

B. Edge anchoring and borders.

C. Shock absorbing course.

D. Correction of grades and subgrade.

E. Drainage layer.

### 1.02 RELATED REQUIREMENTS

A. Section 01 21 00 - Allowances: Cash, testing, and contingency allowances.

B. Section 03 30 00 - Cast-in-Place Concrete.

C. Section 31 22 00 - Grading.

D. Section 31 23 16 - Excavation.

E. Section 31 23 16.13 - Trenching.

F. Section 31 23 23 - Fill.

G. Section 32 31 13 - Chain Link Fences and Gates.

H. Section 33 42 11 - Stormwater Gravity Piping.

### 1.03 REFERENCE STANDARDS

A. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

C. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

E. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

F. ASTM D6662 - Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards; 2022.

G. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment; 2022.

H. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use; 2021.

I. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021.

J. ASTM F1936 - Standard Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field; 2010 (Reapproved 2015).

K. ASTM F2898 - Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method; 2011 (Reapproved 2019).

L. ASTM STP322-1 - Field Testing of Soils, Chapter 1: Field Percolation Tests for Sanitary Engineering Application; 1962.

M. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2015.

## 1.04 ADMINISTRATIVE REQUIREMENTS

A. See Section 01 30 00 - Administrative Requirements - Administrative Requirements, for project meetings.

B. Preinstallation Meeting: Conduct preinstallation meeting _____ prior to start of work of this section; require attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

## 1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.

C. Shop Drawings, Carpet Roll: Show locations of seams and methods of seaming.

D. Samples: For each product for which color must be selected provide color chart showing full range of colors.

E. Samples: Provide following prior to ordering material:
   1. Synthetic Grass carpet: Two 12 inch by 12 inch (305 mm by 305 mm) pieces.
   2. Infill material: Two 1-gallon bags for each type.
   3. Seamed synthetic grass carpet: Two 12 inch by 24 inch (305 mm by 610 mm) pieces seemed together for each seaming method indicated on drawings.

F. Percolation Test Report: Describing test method used and results.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Maintenance Data:
   1. For manufactured surfacing products, provide manufacturer's recommended maintenance instructions and list of repair products, with address and phone number of source of supply.
   2. For loose fill surfacing products, provide detailed re-ordering information to enable Owner to match installed material exactly.

J. Manufacturer's Field Report.

## 1.06 QUALITY ASSURANCE

A. See section 01 40 00 - Quality Requirements, for procedures for testing, inspection, mock-ups, reports, certificates, use of reference standards.

B. Maintain one copy of latest edition of ASTM F1487 and CPSC Pub. No. 325 at project site.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store synthetic grass surfacing to project site in accordance with manufacturer's recommendations.

B. Store materials in dry, covered area, elevated above grade.

## 1.08 FIELD CONDITIONS

A. Ambient Conditions: Cease work of this section when:
   1. Temperatures are below 55 degrees F.
   2. Humidity levels are above adhesive manufacturer's requirements.
   3. Rain is imminent or falling.
   4. Surfaces are wet or damp.

## 1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals - Closeout Submittals, for additional warranty requirements.

B. Provide 15 year minimum warranty from date of substantial completion for materials and installation covering:
   1. Excessive wear.
   2. Fiber tensile strength.
   3. Deterioration or fading from UV light.

# PART 2 PRODUCTS

## 2.01 SYNTHETIC GRASS SURFACING

A. Synthetic Grass Carpet: Yarn fibers tufted through and adhered to porous fiber backing.
   1. Total Weight: Product face weight will be 48 oz. With backing, the total weight of the product will be 103 oz., minimum.
   2. Blades:
      a. Primary blades are a slit film Polyethylene with anti-microbial agent integrated into the yarn. Anti-static technology must also be integrated into the construction so as to not allow static charge build-up. Secondary blade is a heat textured nylon monofilament. Tufting construction requires dual primaries in the same row.
   3. Tufting: the tufting guage will be 3/8", pile height 1-1/2". Tufting configuration - dual yarn same row setup.
   4. Backing: The backing shall be a multi-layered, three part system:
      a. First single layer (stabilized primary consisting of polyester, fiberglass, and polyurethane).
      b. Second layer is a minimum 40 oz urethane layer.
      c. Third layer is nonwoven, recycled, geotextile fleece.
   5. Seams: Primary seaming system shall be a micromechanical seam, utilizing hook and loop technology.
   6. Resilient subsurface padding: Safety Foam Pad which is a closed cell expanded polypropylene panel.
   7. Permeability: 10 inches (254 mm) of water per hour, minimum.
   8. Roll: 15 feet (4.6 m) feet wide, minimum.
   9. Noncombustible: Pass ASTM D2859 for flammability.
   10. Products:
      a. Basis of Design: ForeverLawn, Playground Grass: Ultra
      b. Synlawn; Synsport: Synpro Pet / Synpro Play: www.synlawn.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Synthetic Grass Infill: 3.75 - 4 lbs. of 12/20 silica sand, Envirofill, or TCool per square foot., minimum at 50 to 50 percent granule to synthetic sand.

C. Shock Absorbing Course:
   1. Resilient subsurface padding: Safety Foam Pad which is a closed cell expanded polypropylene panel.
      a. Depth: 1"
      b. Provided with drainage holes.

## 2.02 MATERIALS

A. Edge Anchoring: Wood-polymer composite lumber complying with ASTM D6662; factory finished, free of sharp vertical edges, protruding elements, and trip hazards, capable of being secured to border.
   1. Minimum Edge Radius: 1/2 inch.

B. Border: Permanent element surrounding edge anchoring, consisting of sidewalks and curb with chain link fence:
   1. Sidewalks: As indicated on drawings.

2. Cast-In-Place Concrete Curb: 8 inch wide by 12 inch deep, smooth top and rounded edges. Ready mix concrete in compliance with ASTM C94/C94M.
3. Chain Link Fence: As indicated on drawings.

C. Drainage (Loose Surfacing) Course: Fractured, non-rounded gravel; washed; free of dust, clay, dirt, organic material, hazardous substances, or foreign objects; rounded particles, either naturally or mechanically; sieved in compliance with ASTM C136/C136M in specified gradation range.
1. Base Layer: Percent Passing Sieve Size 3/4 inch: 100 percent.
2. Percent Passing Sieve Size 3/8 inch: 100 percent at a depth of 1 inch.
3. Percent Passing Sieve Size No. 4: 0 percent.

D. Drainage Pipes: Uniform material, free of defects:
1. Basis of Design: ADS AdvanEDGE Pipe - 12 inch.
2. Shape: Flat panel.
3. Perforations: 15 square inches/ft
4. Size: 12 inches
5. Installed at 20' on center or per manufacturer's recommendation.

E. Geotextile: Nonwoven polypropylene sheet.

### 2.03 ACCESSORIES

A. Fasteners, Synthetic Grass to Edging: 1 inch stainless steel staples, in compliance with ASTM F1667.

B. Fasteners, Edging to Border: Self drilling, stainless steel screws, in compliance with ASTM F1667.

C. Fasteners, Seams:
1. Seamed together using micromechanical seaming system as the primary bond.
2. Sewing Thread: As recommended by manufacturer.

D. Rebar: Number 4 rod.

E. Cementitious Grout: Fine, in compliance with ASTM C476.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Lay out entire project perimeter as indicated on drawings prior to starting work.

B. Measure location of all synthetic grass elements, including perimeter of existing synthetic grass surfacing, access and egress points, hard surfaces, walls, fences, and structures.

C. Verify location of underground utilities and facilities in project area. Damage to underground utilities and facilities will be repaired at Contractor's expense.

### 3.02 SUBGRADE

A. Excavate unsuitable soils, see Section 31 23 16. Backfill with suitable material, see Section 31 23 23.

B. Correct irregularities to ensure that required depth of drainage layer can be installed, and elevation is in accordance with manufacturer's requirements.

C. Remove all obstructions that extend into drainage layer within composite nailer boards.

D. Perform rough and finish grading, see Section 31 22 00.

E. Shape to profile indicated on drawings and compact by proof rolling to minimum 95 percent, in compliance with ASTM D698.

F. Flatness Tolerance: 1/2 inch in 10 feet, maximum.

G. Perform percolation test at lowest elevation of subgrade, in compliance with ASTM STP322-1.
1. Report results to Architect.
2. If percolation is less than 1 inch in 3 hour period, do not proceed.

H. Verify that subgrades are at proper elevations and that smooth grading is complete.

### 3.03 TRENCHING AND BACKFILLING

A. Lay out trenching for entire drainage network prior to excavation, as indicated on drawings.

B. Excavate trenches in accordance with drawings.

C. Mirror base of trenches to finish grade.

D. Open trenches require presence of daily site activity.

E. Repair deviations from plans after drainage pipe installation and prior to installing geotextile.

F. See Section 31 23 16.13 for trenching.

### 3.04 DRAINAGE PIPE

A. Install all piping and fittings as indicated on drawings.

B. Install collector lines prior to laterals with deepest excavations first.

C. Connect collector lines to discharge outlet prior to field use.

D. Completion of installation in accordance to design requires approval by Architect.

E. See Section 33 42 11 for drainage pipe.

### 3.05 GEOTEXTILE

A. Verify that subgrade is free of ruts or protruding objects.

B. Install geotextile over subgrade in drainage trenches first, prior to field installation.

C. Lap minimum 36 inches width at seams. Adhere seams in accordance with manufacturer's recommendations.

D. Install smooth, and free of tensile stresses, folds, or wrinkles.

E. Protect from clogging, tears, or other damage during surfacing installation.

F. Repair or replace damaged geotextile in accordance with manufacturer's recommendations.

### 3.06 DRAINAGE AGGREGATE

A. Loose Fill Surfacing:
   1. Flatness Tolerance: 1/4 inch in 10 feet, maximum.
   2. Correct high and low areas in accordance with design drawings.
   3. Match top of layer with top of edge anchoring.
   4. Prevent base stone from entering into loose fill surfacing layer. Prevent loose fill from entering into base stone layer.

B. Base Stone:
   1. Flatness Tolerance: 1/2 inch in 10 feet, maximum.
   2. Correct high and low areas in accordance with design drawings.
   3. Mirror base stone elevations to final elevations.
   4. Prevent disturbance to geotextile during installation.
   5. Approval of drainage piping by Architect required prior to commencement of installation. Prevent disturbance of drainage piping during installation.

### 3.07 SHOCK ABSORBING COURSE

A. Impact Mats:
   1. Prefabricated Cushion:
      a. Lay tile with cut end tiles of equal width.
      b. Bond tile to substrate with adhesive recommended by manufacturer.
      c. Make cutouts around equipment not more than 3/8 inch in width; remove and refit tile as required to reduce gaps.
      d. Fill and seal gaps around equipment with sealant.

### 3.08 EDGE ANCHORING

A. Layout composite nailer boards. Approval of locations by Architect required prior to installing.

B. Install along full perimeter of synthetic grass.

C. Fasten to border with case hardened screws at 24 inch on center, minimum.

D. Set top of edging flush or recessed 1/2 inch below top of border, maximum.

### 3.09 BORDER

A. Verify that site furnishings and composite nailer boards located within project area are complete.

B. Sidewalks: Match to top elevation or increase by 1/2 inch above edge anchoring, maximum. See Section 03 30 00 for cast-in-place sidewalks.

C. Concrete Curb: Install concrete curb in new projects with perimeter fence separating synthetic grass from adjacent areas. Elevate curb 1-1/2 inch higher than outside soil surfaces. Slope top surface outward from synthetic grass. See Section 03 30 00 for cast-in-place curb.

D. Chain Link Fence: Align centerlines of fence and curb. Apply grout to each curb hole installed with fence post, securing post in place. See Section 32 31 13 for chain link fences and gates.

### 3.10 SYNTHETIC GRASS

A. Carpet Rolls:
   1. Unroll all carpet in same direction.
   2. Prevent seams from being located over impact mats.
   3. Allow carpet to rest for at least 4 hours after unrolling and prior to seaming.
   4. Smooth seams and edges, eliminate overlaps and gaps.

B. Seaming:
   1. Cut: Straight, with clean and smooth edge.
   2. Method:
      a. Micromechanical: Utilizing hook-and-loop fasteners.

C. Securing: Staple carpet to edging 1 inch (25 mm) on center.

### 3.11 INFILL

A. Apply during dry weather without signs of moisture on synthetic grass.

B. Thoroughly brush synthetic grass prior to infill installation.

C. Apply infill uniformly in multiple lifts, brush fibers between each application.

D. Measure depth to confirm accordance with plans.

### 3.12 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Drainage aggregate completion requires approval by Architect.

C. Owner or Owner's representative will inspect synthetic grass after installation to verify that surfacing is of proper type and meets specified design safety and accessibility requirements.

D. Repair or replace rejected work until compliant with specified requirements and design criteria.

E. Confirm rainfall permeability meets design, per ASTM F2898.

F. Confirm impact attenuation meets design, per ASTM F1936.

G. Replace damaged products before Date of Substantial Completion.

### 3.13 CLEANING

A. Clean surrounding areas of excess construction materials, debris, and waste.

B. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

### 3.14 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Restore adjacent existing areas that have been damaged by work of this section.

**END OF SECTION 32 18 13**

## SECTION 32 31 13
## CHAIN LINK FENCES AND GATES

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Wire fabric.

C. Concrete.

D. Manual gates with related hardware.

E. Accessories.

### 1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

### 1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

E. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2025.

F. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

G. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

### 1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

D. Samples: Submit two samples of fence fabric, slat infill, 1 inch by 6 inch in size illustrating construction and colored finish.

E. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and other details.

F. Manufacturer's Qualification Statement.

G. Fence Installer Qualification Statement.

### 1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

### 1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Chain Link Fences and Gates:
   1. Master-Halco, Inc: www.masterhalco.com/#sle.
   2. Merchants Metals: www.merchantsmetals.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 COMPONENTS

A. Line Posts: 2.38 inch diameter.

B. Corner and Terminal Posts: 2.88 inch diameter.

C. Gate Posts: 3-1/2 inch diameter.

D. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.

E. Fabric: 2 inch diamond mesh interwoven wire, 9 gauge, 0.1483 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.

F. Tension Wire: 6 gauge, 0.1920 inch thick steel, single strand.

G. Tie Wire: Aluminum alloy steel wire.

### 2.03 MATERIALS

A. Posts, Rails, and Frames:
   1. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
   2. Line Posts: Type I round in accordance with FS RR-F-191/1D.
   3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
   4. Color: Black

B. Wire Fabric:
   1. ASTM F668 polymer-coated steel chain link fabric.
   2. Color: Black

C. Concrete:
   1. Type specified in Section 03 30 00.

### 2.04 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

B. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Manual.

C. Latches: Finished to match fence components.
   1. Brackets: Round.
   2. Locking: Mechanical.

### 2.05 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

### 2.06 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.

B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.

C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

D. Accessories: Same finish as framing.

E. Color(s): Black.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

### 3.02 PREPARATION

A. Removal: Obstructions or debris.

B. Ground Preparation:

### 3.03 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Line Post Footing Depth Below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.

F. Provide top rail through line post tops and splice with 6 inch long rail sleeves.

G. Install center brace rail on corner gate leaves.

H. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

I. Position bottom of fabric 2 inches above finished grade.

J. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

K. Peen all bolts upon installation.

### 3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Do not infringe on adjacent property lines.

### 3.05 CLEANING

A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

B. Clean fence with mild household detergent and clean water rinse well.

C. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

D. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

### 3.06 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

**END OF SECTION 32 31 13**